THE QUARTERLY

JOURNAL OF SCIENCE.

No. V.

JANUARY, 1865.

PUBLIC LIBRARY,
DETROIT, MICH.
MAY 8 1890

LONDON:
JOHN CHURCHILL AND SONS, NEW BURLINGTON STREET.
To whom Communications for the Editors and Books for Review may be addressed.

Paris:
VICTOR MASSON ET FILS.

Leipzig:
LUDWIG DENICKE.

PRICE FIVE SHILLINGS.

London: Printed by W. Clowes and Sons, Stamford Street and Charing Cross.

XUM

THE QUARTERLY

JOURNAL OF SCIENCE.

JANUARY, 1865.

ORIGINAL ARTICLES.

THE SCIENCE AND ART DEPARTMENT.

In the Introduction to this Journal we announced, as a portion of our programme, the discussion of Scientific questions allied to politics,* and we referred more especially to the action of the Department of Science and Art in promoting Science instruction throughout Great Britain.

This intention we have hitherto fulfilled only so far as to publish on two occasions the lists of gold medallists at the State Examinations; but in our last Number we promised to devote a portion of our space to the consideration of the whole subject, and that we now propose to carry out with strict impartiality. The last observation is rendered necessary by the fact, that the criticisms with which we shall feel it our duty to accompany a brief review of the history of the South Kensington Science movement, will not be of the most flattering kind, so far as they concern those persons who have directed the scheme during the last three or four years; but the only personal feeling we have in the matter, is one of regret, that a movement which we have endeavoured earnestly, though humbly, to promote by word and deed, should present so unfavourable a retrospect, and be marked by such grave acts of injustice as those by which we shall find it to be characterized. Inviting our readers, more especially the uninitiated, to follow with us the history of the scheme from its commencement, we find that in the year 1859, only five years since, the Committee of Council on Education, of which Lord Salisbury was then the President, offered to professional men who had been favoured with a scientific education, a moderate but honourable remuneration, to induce them to enlist in the service of the State, for the purpose of extending the usefulness of the Science and Art Department; and they further sought to secure for their excellent project the honorary aid of persons throughout the length and breadth of the land, who, from purely disinterested motives

* 'Quarterly Journal of Science,' vol. i. pp. 21, 22.

desired to promote the cause of Science, and to raise the intelligence of the industrial classes. The former were to act as Science teachers, the latter as committees of management under the guidance of the State.

Industrious and self-denying men of Science were told that if they would qualify themselves by the requisite studies, and by passing an examination that would entitle them to become certificated teachers, they would receive, *whilst actually engaged in "giving instruction in a school or Science class for the industrial classes, approved by the Department," "annual grants,"* according to the grade of their certificates.

"For the 1st grade of competency - - 20*l.*
„ 2nd „ „ - - 15*l.*
„ 3rd „ „ - - 10*l.*"*

And these sums were to be paid without reference to the small fees which they might receive from their students.

The State further told them, that in order to assist them in raising their students to the highest state of proficiency, it would give to the latter prizes and medals; and that payments would be made to the teacher, "on each first class Queen's Prize obtained by the student, 3*l.*; on each second class, 2*l.*; and on each third class, 1*l.*"†

To gentlemen who had the leisure and inclination to co-operate with them through the formation of schools or Science classes, my Lords said, if you will apply to us through your managers "*for a certificated teacher*," or for the certification of any teacher, we will provide you therewith.‡

Admirable was the operation of this "minute." Annual examinations were held at South Kensington, to which scientific men hastened to take their degrees; some with a view to take office under "the Department," others to make themselves acquainted with the routine practised by the Committee of Council on Education, and thus the more effectively to give their aid as honorary promoters of Science classes.

There can be no mistake concerning the intention of the State when this scheme was set on foot, and whoever reads carefully the wording of the regulations in the Report referred to, will be satisfied that it was meant to convey the impression that those who entered its service would be remunerated by annual payments of the amounts specified, so long as they were engaged in teaching under the Department; and neither teachers nor members of committees could for an instant suppose that these payments would be rapidly diminished, and that the State would speedily shake off its responsibilities and leave them to shift for themselves.

But this, we shall find to have been the case.

At first it was found a very difficult matter to set the machinery at work, and the most creditable efforts were made by the Department to establish classes throughout Great Britain.

Earl Granville, who followed Lord Salisbury as President of the

* 'Sixth Report of the Science and Art Department, 1859.'
† Ibid. ‡ Ibid.

Committee of Council on Education, took a deep personal interest in the movement, and visited some of the provincial towns, where efforts were being made to establish schools. But even at this early stage of the proceedings, there were indications that the movement was not to be characterized by that high tone of morality, by that scrupulous honour, which should distinguish all philanthropic schemes, more especially such as are undertaken by the State.

In their efforts to establish classes, the heads of the Department sometimes pushed their zeal beyond the limits of discretion. The lectures delivered by the officials, as, for example, that of Captain Donelly, the Science Inspector, which was read on the 4th February, 1861, at South Kensington, and was afterwards published along with several others by the examiners, were all well adapted to secure the desired end; although, in reference to Captain Donelly's lecture, we cannot help remarking, that it sounded the first note of disavowal, and was calculated to shake the confidence of those who read it, in the *bonâ fide* intentions of Government. But in the selection of its emissaries to the provinces, the Department was by no means so happy as in that of its metropolitan advocates; and a certain Mr. Buckmaster, who called himself the "organizing teacher," but whose name will not be found in any of the printed lists of officials attached to the "Directories," was the chief instrument employed for the establishment of new classes. This gentleman, who possesses a high degree of energy combined with an equally large amount of volubility, succeeded by the promises which he held out on behalf of the State in promoting the establishment of several new classes. We have heard it said, however, that the Department could not always recognize the validity of these promises, as some of them were not in strict accordance with its regulations; and although complaints were made to the highest authorities, this gentleman was subsequently retained by the Department, "unattached," it is true, and has been rewarded for his services in a somewhat equivocal manner, to be described hereafter.

The result of the efforts made by the Department to establish classes—the impetus given by the first swing of the pendulum—has been astonishing; and notwithstanding the serious drawbacks which followed, we find this result to be represented by the following data:—

In the year 1859, the classes were five in number; in 1864, ninety-five. In the Report of 1859 we find mention made of five students who had taken certificates as Science teachers; in 1864, the list of certificated teachers comprises 332 names, some being of men of the highest standing and intelligence; and whilst we find no record of the number of students taught in the five schools which were in existence in 1859, the number of those who attended the 95 classes of 1864 was 3,560.

But we must review cursorily the action of the State in the interim, and we fear that some features will present themselves which will tend materially to qualify the admiration wherewith every one must regard this effort to improve the intelligence of the industrial classes.

Every year, since the publication of the Sixth Report, a 'Directory' containing revised regulations has been issued by the Science and Art Department, and in that of 1860 (the minute of 1859 not having as yet produced the desired effect), the questions of certificate money, Queen's prizes, and all other matters of a similar character, were allowed to remain unchanged; early in 1861, however, appeared Captain Donelly's lecture, in which the Department of Science and Art was declared to be "now the constituted machinery for giving State aid to certain branches of instruction;" but a gentle hint was given to those whom it might concern, that whilst the Government would grant such aid with as little interference as possible, yet it *might* hereafter reduce or eventually withdraw the stipends of teachers. This announcement was accompanied by appeals to the patriotism and *amour propre* of committees to make the movement self-supporting, so that it might require less and less "cockering up by State aid."

The fact is, that a contest for the loaves and fishes had begun between the Science and Art Department and the Education Department of Whitehall, the latter being represented by Mr. Lingen, who, jealous of what appeared to be the preference shown to Science instructors, after the screw had been adjusted all over the country in National schools, showed his appreciation of high mental acquirements, by manifesting a desire to see Masters of Arts of Oxford and M.D.'s of London, who might be engaged at the invitation of Government in teaching Natural Science to artisans for 20*l.* or 40*l.* per annum, placed on the same footing with village instructors in spelling and the first rules of arithmetic.

In fact, these gentlemen must no longer be paid according to the rank of their attainments, but, as in the other case, "upon results." We shall see presently how far *that* system (the system of results) was adhered to; but meanwhile we must mention, that the Department of Science and Art was powerless to resist the encroachment, and, although it consoled itself with having gained the questionable advantage previously denied to it, of granting aid to certificated teachers in elementary schools, who felt disposed to give their services as Science teachers, we find in a second revised 'Directory' issued in 1862 (for there were two 'Directories' published in that year), that all the previous conditions upon which the teachers had been engaged were annulled, and their payments were to be regulated solely by the number and proficiency of passed students.

Thus, it mattered not whether the teacher was a lecturer of high scientific attainments to whom a "diploma,"* or a first grade certificate, had been granted, or whether he was a teacher in a village school who had managed to obtain a certificate of the lowest grade.

When we have followed the history of the movement a little further, we shall find, that if we were at first disposed to accredit the Government with the sole desire to benefit the "industrial classes" by this change, such an opinion will be untenable, for these have been treated with the same parsimony as their teachers.

* In a few cases diplomas were granted to men of well-known attainments, without examination.

The fact is, the State had undertaken too much, and had not the moral courage to restrict its operations. The 'Directory' of 1862 contained a list of 171 certificated Science teachers against 53 in 1860, and whilst the Government seemed indisposed to increase its expenditure by an additional outlay "in aid," it still permitted their number to increase without limitation. But, in the same 'Directory' we first find the unmistakable announcement (three years after the movement had been started, and one year after it was fairly in operation), that the amount of remuneration to teachers "is liable to be decreased, and altogether withdrawn."

It might perhaps have been pardonable in the State if it had said to the crowds who were flocking in to enlist in its service, "Come, gentlemen, without let or hindrance, and join in our work, we don't mean to pay you much longer, so, the more the merrier, and you may, with the help of your committees continue the work we have so gloriously begun." But was this honourable to those who were already engaged in teaching, or to the committees whose gratuitous services had been secured on the conditions previously announced? We think not; and we think too, that the Government which has so acted, will find that its proceedings have not been dictated by a sound policy.

The state of affairs under the new régime, then, was as follows:—Instead of being paid a fixed stipend varying in value according to the grade of his certificate, &c., the teacher received a grant composed of head moneys—say, for every "passed" student, 1*l.*; for "honourable mentions," 2*l.*; and for 1st, 2nd, and 3rd grade prizemen, 5*l.*, 4*l.*, and 3*l.* respectively.

So far there was not much to be complained of in the change; and it is only fair to Government to say that, on the whole, it appeared to have been dictated by justice and prudence; for if, under the old regulations, a teacher held six first-class certificates in six distinct branches of Science, he could claim 20*l.* upon *each* of those certificates, if he was teaching thirty students in any *one* branch of Science only;* but if he held *one* certificate only, and was teaching 100, or any other number of students, in the branch for which it was given, he could still only obtain 20*l.* on his certificate besides his prize-money, should his students have been successful in obtaining prizes.

Under the new regulations, however, the teacher received the sums above mentioned for *every* passed student, "honourable mention," or prizeman, *without* limit as to number. But then a provision was added, that 5*l.* would be the maximum amount paid upon any one student; and (to cut a long story short) in the 'Directories' of 1863 and 1864, new minutes were issued, which, without any justification or show of reason, reduced the stipends of the teachers apparently in the inverse ratio to their proficiency!

Thus, "If a student be successful at the examination in more than one subject, the teacher can only claim half of the above payments in

* The regulation being that he should be paid 4*l.* per head for every student under tuition, up to the maximum value of each certificate held by him.

respect of such further subject in which he is successful" ('Directory' of 1864, Rule xix.); and again, "Payments are only made on the foregoing scale when they amount to not more than 60*l.*; when on this scale they would amount to more than 60*l.*, the excess up to 40*l.* is diminished by one quarter; the excess above 40*l.* by one-half." (Ibid., Rule xx.) And not only were the emoluments of the teachers cut down, but their duties were increased to an unnecessary degree, the State requiring them in some instances to perform herculanean feats of intellect. In fact, the object of all these changes was sufficiently obvious; it was to increase the labour and diminish the emoluments of the teacher to such a degree as to compel him to dispense with the State aid altogether.

We will give one or two illustrations of the operation of these minutes, and of the wisdom and justice by which they were dictated. Let us suppose that in 1860 a first-grade teacher was imparting instruction in one subject to five pupils, of whom three gained first-class and two second-class prizes; he would receive from the State 20*l.* (4*l.* per head) on his certificate, and 13*l.* prize-money; and suppose that, continuing to teach the same class in 1861, the three first-class prizemen again took first-class prizes and medals in addition, and that the two second-class men improved the grade of their prizes, he would receive no remuneration on the medallists, but still 20*l.* on his certificate and 15*l.* prize money=35*l.*, an advance of 2*l.* for the increased proficiency of his pupils; being in all a sum of 68*l.* for delivering 80 lectures at least to his class in two years.

But now, let us suppose the same teacher to be at work in 1863 and 1864 under precisely the same conditions, and under the revised code, and what would be the result?

In 1863 he would receive no "certificate" money, but 23*l.* on "results," and in 1864, when his five pupils had increased in proficiency in the degree named above, he would receive *nothing* upon his three best pupils who had taken medals, and 2*l.* upon the two who had risen in the scale of prizemen! In short, he would have delivered at least 80 lectures in two years, and instead of the moderate sum of 68*l.* under the old regulations, he would receive the munificent sum of 25*l.* (23*l.* the first year, and 2*l.* the second) for imparting Science instruction to those "who are unable to help themselves!"

But it may be thought that we have selected or supposed the worst possible case to illustrate the operation of the new minutes. This is not the fact; there are worse cases actually in existence. When the Liverpool school was first started in 1861, it supported two lecturers, one gentleman being one of the most successful teachers that had been called into existence by the Department, and the other a medical man, of high scientific and literary attainments, and a graduate of Oxford University. The number of regular students in the school was about 130; and for imparting instruction to these, the Government grant amounted to about 140*l.* or 150*l.* In 1864 the school had materially extended its operations, and possessed two teachers in addition to those referred to; the number of students remained about the same (125), but these had attained a much greater degree of profi-

ciency, some of them having taken high honours in five or six branches of Science.

What does the reader suppose was the amount paid "in aid" to its four lecturers? About 40*l.* or 50*l.* *in all*, with the prospect of that sum being still further reduced, provided the committee should comply with the difficult conditions of the State, and nothing at all if they failed to do so! *

What would our ministers of State and heads of Departments say, if we, the tax-payers of the country, treated them after such a fashion?

It is true that they can point to the figures in their Blue Books and show that they have raised up a vast and useful system of scientific education, without any material increase in the national expenditure; but even those figures will not bear a close investigation.

We find entered in the Report of the Department for 1859 the following items of expenditure:

	£
In aid of teachers of *all kinds* (Art as well as Science) about	15,400
For general management	3,600
Under the head of South Kensington Museum	2,350
In the Blue Book of the year 1864, with its addition of about 330 teachers and 3,500 students, we find the following payments in aid, to *all* teachers as before, about . .	16,500
(or an increase of about 1,000*l.* in six years.)	
"General management"	5,000
(or an increase of about 1,300*l.* in the same time.)	
"South Kensington Museum"	4,200
(or an increase of 1,900*l.*)	

Thus, the salaries of the South Kensington officials had been raised by a sum rather more than the total amount of increase "in aid" of the 300 additional teachers. And besides this, we have the modest little sum of 11,473*l.* 18*s.* 9*d.* (equal to about two-thirds of the total grant "in aid") put down to "Objects purchased for National Art Museum," which we presume to mean, Mr. Cole's hobby at South Kensington!

Again we would ask whether this is fair to the large body of Science teachers?

Why should the salaries of the secretary, and all other officials, increase at the rate of from 40*l.* down to 10*l.* per annum,† and at the same time the stipends of the teachers, who are doing the real *work* of the Department, be materially diminished year by year, and at last entirely confiscated?

We say nothing of the binding nature of the engagement under which teachers were first enlisted, but as taxpayers and men of busi-

* This session—1864-5—the school has with difficulty been started, owing to the mode in which the State has treated the lecturers. The necessarily increased fees of students, have materially diminished their number.

† See 'Civil Service Estimates (Education, Science, and Art).' 1863.

siness, we cannot quietly acquiesce in this mode of distributing the public funds.

And if the teachers have thus fared at the hands of the State, have the students had better justice dealt out to them?

In seeking the reply to this inquiry, we have to consider elements very different from those which affected the interests of the teachers; but even here, so far as the State management is concerned, it leaves much to be desired.

Some credit is due, and has been conscientiously acknowledged by the State, to the Committees who have co-operated with it in the establishment and maintenance of the various schools and classes which have so suddenly sprung into existence, but their chief merit has consisted in the perseverance with which they have endeavoured to maintain the integrity of the institutions, and honourably to fulfil *their* duty towards both teachers and students in the face of the rapidly diminishing State aid, and increasing State interference.

There is no doubt, however, that for the real, lasting benefits which have been conferred upon students, the latter are mainly indebted to their devoted teachers, who, notwithstanding the inconstancy of the State, have never for an instant relaxed their efforts to raise the intelligence of the "Industrial classes." No money payment could adequately compensate the teachers for their services; but we can assure them, after a careful study of the relations existing between them and their pupils, that they have earned the deepest gratitude, and are in possession of the best wishes of those for whom they have laboured so assiduously. To this fact many letters, as well as spoken words, have testified, and it is truly the green spot in this dreary history.

As to the State, it has granted, and still continues to distribute, amongst the students what are called "Queen's Prizes" and Medals. The former are books, and the latter very beautiful medals of gold, silver, and bronze.

The number of books (Queen's Prizes) awarded to each successful student, was from the first judiciously limited, but the binding of those which represented one or more prizes of the first grade was rich and elegant.

Fiscal economy soon, however, dictated unsatisfactory changes even in this paltry matter. The bindings became less attractive, the number of books awarded to each successful student was reduced, and an attempt was made to do away with the second and third grade prizes altogether. The last-named minute was rescinded, owing to the opposition which was raised against it, not, however, without a slight turn being given to the screw in another direction. Some idea may be obtained of the diminished number and value of the prizes from the fact that in 1861–2, the *estimate* for prizes, medals, &c., in Art and Science, was 2,750*l.*; and for 1862–3, 3,000*l.*;* whilst in the return made in 1864, with the vast addition of students that had taken place, the item for all kinds of prizes in Art and Science, is 2,503*l.*

* See 'Education Estimates for 1863.'

But this is not the worst feature in the affair. There is a matter to which the attention of those who are the nominal heads of this Department cannot, we think, have been directed, or we feel confident it would never have been tolerated.

Whatever might be the number of books distributed, or their external appearance, at least it was to be expected that all the works on the list from which students are permitted to make their selection, would be of an unimpeachable standard; that all the prizes indeed would be worthy of the exalted Personage whose gift they are supposed to be.

A cursory glance at the list will, however, satisfy any unprejudiced person that there have been in its compilation considerations other than that of providing successful students with standard works on Science; and we really think that the State did not exercise a sound discretion, nor add to the respect which, it is no doubt desirable, should be entertained for it by young students of Science, when it offered them as a reward for successful study the valuable contributions to our scientific literature of the still "unattached" Mr. Buckmaster. As we have already said, the energy of Mr. Buckmaster has doubtless been of great value to the Department, and the results of his persuasive eloquence are no doubt deserving of an appropriate reward; but the insertion of his little books in the State list is, we venture to think, a very *in*appropriate method of crowning his labours, and it has caused great chagrin in those quarters where, through misplaced confidence, they were selected as prizes; nor has the student any alternative but to select these works in case he takes a low prize and wishes for a book on the subject of which they treat.

Had the section in which they are comprised consisted entirely of such productions, we might have been led to suppose that the Department had taken a leaf out of the book of some of our less liberal Railway Companies, which compel their passengers to ride second-class by making the third as uncomfortable as possible; but when we find in the same group with 'Buckmaster's Elements of Chemistry,' Professor Ramsay's 'Lectures on Physical Geography,' and works of a similar kind, we cannot help feeling that the introduction of the former in the list is attributable to motives which ought not to influence those under whose direction this portion of the public service is conducted. We direct attention more especially to this case, as being one which we think must have escaped the notice of the head of the Department, but there are other "Queen's Prizes," which are open to objection, and no doubt an inspection of them in the proper quarter would lead to beneficial changes in the list.

The mention of Professor Ramsay's name will probably have reminded some of our readers that there is a small body of gentlemen connected with this Department of the State, without a reference to whom, our notice would be very incomplete; we mean the "Professional Examiners for Science."

In the selection of these, the State has exercised great judgment; and this portion of the work of Science instruction is being carried out on the most approved principles. We have from time to time had

occasion in company with able teachers of Science, to peruse the examination papers of several of these gentlemen, and can fully indorse the opinion we have often heard expressed that the whole heart of the examiners is in their work.

Because these gentlemen are moderately remunerated, it does not follow that the students and votaries of Science are under no further obligation to them, and we do not feel it to be a presumption on our part, when, in the name of all interested in the diffusion of sound scientific information, of students, teachers, and committees, we say that they are entitled to our cordial thanks, and to our best wishes. We trust that they may long continue to direct the examinations in their respective departments of Science. Professor Huxley on Zoology; Dr. Lankester, Botany; Professor Ramsay, Geology; Professor W. W. Smyth, Mineralogy; Professor Hoffmann, Chemistry; Professor Tyndall and the Reverend B. M. Cowie, Physics; and Professor Bradley, Geometrical Drawing.

Quitting now the bright side of our subject, we must return for a moment to the question of the teachers' grievances. And it may possibly appear strange to some of those who have followed us in this cursory and imperfect review of the South Kensington Science movement, that if the reductions, which have been made from year to year in their emoluments, had been considered unfair by the masters, they would have broken out into open opposition.

"How is it," they may be inclined to inquire, "that these 'minutes,' have been issued year by year without any *public* protest against their injustice?" For whoever has conversed with teachers and committees, knows well that, privately, much dissatisfaction has been expressed, and that representations to that effect which have remained unheeded, have even been made through the proper channels to the Department.

The reply will be found in the following story, which, though very old, has lost none of its force when applied to the case under consideration.

There once reigned, somewhere in the East, a great tyrant, who, like the Caliph Haroun al Raschid, used to amuse himself by walking abroad alone to hear what people said of his rule.

This bad ruler, having heard of a poor defenceless old woman who possessed four cows, sent down one of his minions to take away one of them, and transfer it to the "Crown." A few days afterwards, when the king was passing the poor woman's cottage in disguise, he heard her, in her devotions, secretly invoking curses on his royal head, and praying for his speedy removal to a better land.

Thereupon he sent an officer to take away another of her cows; and on again passing the cottage shortly afterwards, he heard the old woman reiterate her prayers to the Almighty to punish and remove the tyrant who thus plundered his subjects. The result was, as may be anticipated, the disappearance of a third cow; but when some time afterwards his Majesty was passing by the cottage, he heard, to his astonishment, a voice praying for his long life and unimpaired health. On entering the cottage he was surprised to find a poor decrepit old

creature lying helpless upon her couch, and when he asked her why she offered up such prayers for a tyrant who had deprived her one by one of her most valuable possessions, she told him that after each act of spoliation, she had secretly invoked curses on his head, but that, finding the sole result to be the abstraction of some of her remaining property, she had now changed the tenour of her prayer . . . lest he should rob her of her last cow! It is so long since we read this story that we forget whether the tyrant, whose better instincts prevailed for a season, returned the poor woman her cows, of which she had been plundered, or whether he was content to leave her in the possession of her sole remaining property; but, proceeding to the application of our story, we feel sure that unless the Science teachers of the country bestir themselves manfully they will not be left long in the undisputed possession of *their* last cow.

Like the tyrant in the tale, that section of the State which ought to exercise a paternal influence, and watch over the interests of Science and Art, is far from evoking the *blessings* of the community, and no doubt its faithlessness has often caused, and must still continue to give rise to much secret distress, which the helplessness of the sufferers has compelled them to bear without a murmur.

The question, "Who is responsible for these grievous wrongs?" may be easily answered by any one who has carefully watched the progress of events, and the reply is aptly conveyed in the words of a recent French writer on Social Reform,* who says—"A matter which, in the infancy of the system, would have been managed by the Prime Minister himself—which, in the growth of its intricacy, would have been entrusted to a 'Director-General,' to a 'Director,' to a 'Chef-de-division,' to a 'Chef-de-bureau'—is now only understood in all its details by a 'sous-chef,' whom such petitioners as happen to be well directed manage to find in huge barracks of bureaucracy in Continental capitals. It is this 'sous-chef' who, in the now existing state of things, draws up whole batches of 'minutes,' *which even the most painstaking ministers must often sign unread.*"

Let the reader shift the scene from Paris, or Berlin, to Whitehall and South Kensington, and he will understand the secret of all that mismanagement which has called forth such loud and oft-repeated complaints.

The most anomalous feature in the whole affair, however, is that a glance at the past history of this Science movement serves to show that it was begun in a *liberal* spirit by a Conservative Ministry, but was continued in a spirit neither conservative nor by any means liberal, by a "Liberal" Ministry.

It may, perhaps, be suspected that in pointing out this circumstance, we have some political motive, beside the real question at issue; but this is, most assuredly, not the case. The circumstance has been brought under our notice by persons to whom we have complained of the course adopted by the State, and the reply (suggested, no doubt, by party feelings) has often been—"Yes, it is

* 'La Réforme Sociale en France,' &c. Par M. Le Fay.

very wrong, and you will have no redress until we have a new Ministry."

We do not mean to seek notoriety, nor to curry favour with any "party," by an attack upon the existing Government; neither is it our intention to denounce that Department of it which has so completely belied the great principles of the Liberal party. The former would be to us a distasteful proceeding, and the latter, which has often been effected with scathing sarcasm, would simply be injurious, and of no avail towards securing the end we desire—namely, *justice*.

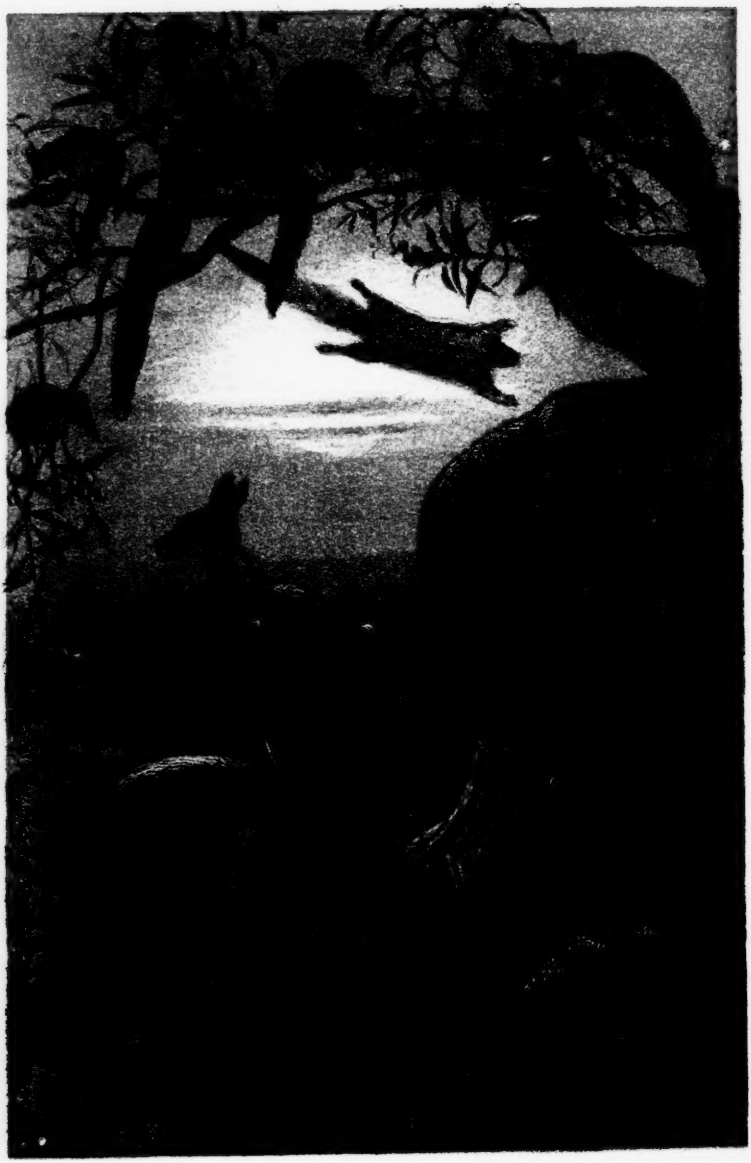
Instead of reaping a reward for the freedom with which we have commented upon the shortcomings of one section of the State, we must even be prepared to incur a considerable share of ill-will, and to lose some friendships. But, however we may have to deplore the one, or to miss the other, we shall be well satisfied to abide by the consequences, if the mischief which has been done be but speedily repaired. The plea of "economy," in justification of the course that has been adopted, is a wretched one; and we express and endorse the opinion of one of the leading financial reformers of the day, in stating that the very last item of the national expenditure which the people of this country would desire to see curtailed, is the unimportant one which provides for the intellectual improvement of the masses.*

As it is, however, not safe to be too sanguine, and to expect that the State will voluntarily retrace its steps, we must, as an alternative, address a few words of counsel to the Science teachers of the country. Their strength, and perhaps their only hope of redress, lies in concert and agitation, those two talismans which have so often wrought wonders upon obdurate rulers, and it has frequently been a matter of surprise to us that they have sat still, and looked on patiently, whilst acts of injustice have been committed, without making any attempt to form themselves into a protective Association. The rapid modes of intercommunication which now exist would render such a scheme easy of accomplishment, and the delegates from various districts in the United Kingdom could easily hold an annual Conference, which might not only consider the best means of guarding the interests of the teachers, but of promoting the work of Science instruction.

If the more prominent and influential teachers choose to bestir themselves, and to prevent the body from remaining any longer a bundle of loose fagots without bond or tie, they will no doubt find many who are willing and ready to give them material and moral support (should this be requisite), and gentlemen of influence in Parliament willing to represent their interests.

But, to be effective, such a movement should not be long delayed. A dissolution of Parliament cannot be far distant, and besides the value, at such a juncture, of an associated body prepared to act as a whole, it would no doubt be found that many of its individual mem-

* In the year 1861-2, when this scheme of Science Instruction may be said to have been in active operation, the total amount of money expended on 'Education, Science, and Art,' was 1,359,996*l.*, of which 'Science and Art' received 111,484*l.*, and of this latter sum, the amount devoted to Science and Art *tuition* (salaries and payments in aid), was 17,500*l.*! and for rewards to students 2,750*l.*



J. Wolf del et lith

M & N Hanhart imp

TYPICAL MAMMALS OF AUSTRALIA

XUM

bers would be well able to wield the pen, and might exercise considerable influence upon Constituencies. For the present, then, we reserve further comments, but when the proper time arrives, our aid will not be found wanting, and if it be required, the little influence we possess will be at the service of those whose interests these remarks are intended to protect, and with whose labours in the cause of Science we have the most sincere sympathy.

THE MAMMALS OF AUSTRALIA.

By P. L. SCLATER, M.A., Ph.D., F.R.S., Secretary to the Zoological Society of London.

THE remains of extinct organisms have long since been adopted by geologists as the only sure guide to the age of the strata in which they are entombed. However dissimilar two formations may be in other points, it is now universally acknowledged that, if they furnish the same fossils, they must be considered as of the same period of deposition. However much two formations may resemble each other in composition, it is quite certain, if their fossils differ, that they must be attributed to different geological epochs. Concerning the origin of life upon this planet we can say nothing. But as to its progress, we now know that from the remotest time to which we have yet traced it back to the present moment, it has gone on in one constantly-flowing but ever-varying stream, slowly yet surely changing its aspect as it moves forward, and never returning at any subsequent period to the same appearance as that which it has before presented. The further it advances, the greater is the amount of variation. The present Flora and Fauna of the earth is more like that of the tertiary period than that of the secondary, and the further we go back into primeval time, the greater divergence we find in the aspect of the animal and vegetable kingdoms. Thus it follows that the amount of difference between the organic life of two successive epochs becomes a measure of past time, and since the antiquated notion of an indefinite number of separate creations has been discarded and the great fact of the *unity* of organic nature acknowledged, it has been generally recognized as such by all true philosophers.

But it is not only the whole stream of life upon the globe that is perpetually altering its general appearance; each branch of it, as it diverges from the parent stream, acquires an individuality of its own, and becomes more different the longer it is separated from the main channel. Upon re-entering this it again mixes with the general current, and gradually loses the destructive features it has previously acquired. This seems to have been the case with the Fauna of Australia. Australia, judging from our present confessedly very imperfect knowledge of the history of its organic life, must have been separated from the great mass of land which forms the Old World at a time when Marsupialism was the prevalent, if not the only, form of

Mammalian life in existence upon our planet. During the ages which followed, the higher orders of the Mammalian series became developed in the great Paleogean Continent, while, for reasons which at present we cannot explain, Marsupialism remained permanent in Australia, and a varied series of herbivorous, insectivorous, and carnivorous Mammals, all united by the common link of this mode of reproduction, were developed in this isolated region. In comparatively recent times the water-strait between Australia and Asia again became narrowed, and placental forms of Mammals have thus penetrated into the former land of Marsupials.

It has thus, as I believe, come to pass that in Australia we find the Mammalian Fauna composed of two elements—the implacental and the placental; the Mammals of the former type being the old indigenous denizens of the country; the latter to be regarded as probably nothing more than intruders of comparatively recent introduction. Let us first consider the former and more characteristic portion of the Australian Mammal-fauna.

Beginning with the lowest Implacentals, we first meet at the outset with two forms of life so very different from the rest of their kindred, that they are now universally allowed to rank as a separate order, and by some of our most eminent authorities even as a distinct sub-class of the Mammalia. These are the extraordinary genera *Ornithorhynchus* and *Echidna*, which in their toothless jaws, in the conformation of the sternum and scapula, and especially in the structure of their reproductive organs, exhibit such unmistakable signs of divergence towards the class of birds, as to have acquired the name of *Ornithodelphia*. The *Ornithorhynchus* inhabits the South-eastern portion of the Australian continent and Tasmania. Of the genus *Echidna* two species are commonly recognized—*E. hystrix* of the southern parts of Australia, and *E. setosa* of Tasmania. These three animals are the sole existing representatives of the class Monotremata, and would of themselves be sufficient, even were all other signs absent, to stamp the region that they inhabit as a land of zoological marvels.

The second order of Implacental Mammals, although not absolutely restricted to Australia, since one distinct branch of it is purely American, constitutes perhaps a still more characteristic feature of its Fauna than even the Monotremes. At all events the Marsupials are so abundant in genera and species as to form by far the most prevalent portion of the Australian Mammal-fauna. While all the classes of Placental Mammals represented in Australia only furnish about 53 species belonging to 11 genera, upwards of 100 distinct species of Marsupials appertaining to 16 generic forms are already registered in our catalogues, and there is no doubt that in the little known districts of the north and west, others still await the researches of future explorers. Following the views of Mr. Waterhouse, I divide the Australian Marsupials into five families: the Macropodidæ, or Kangaroos; the Phascolomyidæ, or Wombats; the Phalangistidæ, or Phalangers; the Peramelidæ, or Bandicoots; and the Dasyuridæ, or Dasyures.

The Kangaroos or Macropodidæ must be considered as *par ex-*

cellence the most important group of the Australian Mammal-fauna. They are at once the most numerous in species, and in the former condition of Australia, before the influx of Europeans took place, were probably likewise the most prevalent form of Mammalian life as regards individuals. In his great work on the Mammals of Australia, Mr. Gould has devoted the whole of the second volume to the illustration of the members of this family, figuring no less than 44 species, and although some of these will be looked upon by most naturalists as rather in the light of local varieties than species, it is probable that the Australian Fauna embraces not less than 50 well-defined members of this beautiful group of animals. These are divisible into two genera—*Macropus* and *Hypsiprymnus*. The former genus contains the larger Kangaroos with the upper canines usually deciduous, when present, and the toes of the fore-feet nearly even; while *Hypsiprymnus* embraces the Kangaroo-Rats, as they are usually termed, which are all of smaller size, possess well-developed canines, and have the central toes of the fore-feet proportionately larger, so as to accommodate their digging habits. Of the true Kangaroos Mr. Gould has included 39 species in his above-mentioned work, while the Kangaroo-Rats are less numerous, some ten only of this group being at present known to Science.

The second family of Australian Marsupials—the Phascolomyidæ—are numerically of much less importance than the preceding, although the form and general appearance of the animals of the single known genus *Phascolomys* is hardly less *outré* than that of the Kangaroos. Until very recently but one species of this group was accurately known, although so long ago as in 1845, Professor Owen had characterized a second from the form of its skull. While further information is still required upon this species, a second very distinct form of the group, remarkable for its hairy muffle and pointed ears, has been received from South Australia,* and Mr. Gould figures two others—one of which may possibly be identical with Professor Owen's species. In general structure the Wombats are closely allied to the next family, the Phalangers—although their exclusively terrestrial habits naturally involve minor points of difference, which added to the somewhat trenchant characters presented by their dentition, have induced naturalists to recognize them as a separate family.

The Phalangistidæ, which next follow, are a much more extensively developed group of animals, presenting us with several well-marked generic forms, and nearly twenty readily distinguishable species in the Australian Mammal-fauna. While the Kangaroos are mostly grazing animals, and the Wombats burrowers and grubbers, the Phalangers are essentially arboreal in their habits and much more strictly nocturnal than the two former groups. In the daytime the Phalangers lie concealed in the hollow of trees, issuing forth at night to feed amongst the branches upon "leaves, buds, and fruits." The Koala or "Native Bear" (*Phascolarctos*), of which form a single isolated species only is known, serves to connect the Phalangers with the Wombats—being

* Phascolomys lasiorhinus, Gould, Mamm. of Austr., ii. pl. 59, 60.

allied to the latter by many characters, and amongst others by the absence of a tail, which distinguishes it from the rest of its family. In *Phalangista*, *Cuscus*, and *Dromicia*, the more typical forms of the Phalangistidæ, which next follow, the tail is not only well-developed but of vital importance to the animal, being used as a prehensile organ. The Flying Phalangers of the genera *Petaurus*, *Belideus*, and *Acrobates*, do not employ their caudal appendages in the same way. But this organ which is much elongated in all these groups, and densely clothed with hair, serves, along with the membrane extended between the fore and hind legs, in the manner of the Flying Squirrels (*Pteromys*), to support the animal in the air when descending from the top of one tree to the base of another. One more very singular little animal must be enumerated before we leave the Phalanger family—the *Tarsipes rostratus*—small in size but great in interest, even among the many abnormal forms of this wonderful land. The Tarsipes is of the size and general form of a mouse, but "with a long slender pointed muzzle," and the "nails of the toes for the most part embedded in the upper surface of the expanded fleshy pads with which they are terminated," thus affording some resemblance to the *Tarsius spectrum* of the Indian Archipelago, whence its name is derived. Another peculiarity of the *Tarsipes* is that its food appears to be exclusively honey—no other substance having been found in the stomachs of the specimens examined, and its long and slender tongue being obviously adapted, like the bill of the Humming-bird, and the brush-tongue of the Lories, for collecting such food.

The Peramelidæ or Bandicoots—the fourth family of Australian Marsupials—have teeth adapted to an insect diet, thus leading off towards the truly carnivorous group of Dasyuridæ, although we know from the records of trustworthy observers that some of the species feed more or less upon vegetable substances. Such is certainly the case with the *Perogalea lagotis*, or root-feeding Dalgyte, of Western Australia, which is abundant over the grassy plains of that colony, and from its burrowing habits and large hare-like ears, is commonly known as the "Native Rabbit." Of the typical genus *Perameles*, some six or seven forms are known, which are distributed all over Australia, each colony having its peculiar species. They are all purely terrestrial animals, some inhabiting the densest scrubs, and others the hot stony ridges of the upland plains. The only remaining member of the family is the anomalous *Chœropus castanotis*, which is confined to the hard stony grounds of the interior of the Southern colonies. Although agreeing in essential structure with the Peramelidæ, the *Chœropus* differs from its nearest allies, as well as from every other known Mammal, in its peculiar feet, on the fore-limbs only two toes being present, and on the hind limbs but one fully developed, and useful for locomotion.

The Dasyuridæ, which next follow, are the representatives of the Carnivora, in the Marsupial series, and as regards their largest and best developed forms are fully competent to take that place in the economy of Australian nature, which in most countries is filled by species of the genera *Canis* and *Felis*. Before, however, we mention

these predatory forms, a few words must be said about two genera, which although they belong to the same family are insectivorous, rather than carnivorous, both in habits and structure. One of them—the Banded *Myrmecobius*—constitutes another of those remarkable isolated types, which are so frequent in Australian zoology. The *Myrmecobius*, so called from its food being supposed to be ants, was first discovered in Western Australia, though it is said to have occurred also in the inner districts of the other Southern colonies. It is of about the same size as a common Squirrel (*Sciurus vulgaris*), and in the words of that accurate observer, the late Mr. Gilbert, appears very much like that animal, "when running on the ground, which it does in successive leaps, with its tail a little elevated, every now and then raising its body and resting on its hind feet." Besides the peculiarities of its dentition (among which are its numerous prickly-pointed molar teeth), the *Myrmecobrius* is remarkable for its somewhat harsh fur, and long bushy tail, together with the entire absence of a pouch in the female, so that the young hang on to the nipples of the mother absolutely unprotected, except by the long hairs which clothe the under surface of the abdomen. The latter peculiarity, however, likewise obtains in certain members of the next genus *Phascologale*, of which numerous species are found throughout Australia. Mr. Gould, in his work on the Mammals of Australia, figures seventeen of them, dividing them into several sections, *Phascogale*, *Antechinus*, and *Podabrus*. They vary in size from the *Phascogale penicillata*, which is large and strong enough to plunder the settlers' henroosts, down to the *Antechinus minutissimus*—the smallest of known Marsupials, which is not much bigger than the Harvest-mouse of Europe. Two genera of purely flesh-eating animals follow the *Phascologalæ*, and close the series of Marsupials. These are *Dasyurus* with five species, spread over different parts of Australia, and *Thylacinus* with only one existing species, now confined to the mountainous districts of Tasmania. The latter animal is well known to the frequenters of the Gardens of the Zoological Society of London, as one of the finest and most interesting of the whole Marsupial series. The general external appearance of the Thylacine is so much like that of a large dog, that the uninitiated can hardly be persuaded that its proper place is in another order of Mammals, and even professed naturalists have fallen into the grave error of arranging it with the Carnivora, with which, I need hardly say, it has no real affinity.

Having completed our survey of the Implacental Mammals of Australia, we must now consider the Placental series, which, as has been already shown, plays a very subordinate part in this extraordinary Fauna. Putting aside the three Marine Orders—the Seals, Whales, and Sirenians, which have entirely different laws of distribution, and confining our attention to the terrestrial Mammals, we find only three of the orders, namely, the Rodents, Bats, and Carnivores, with any representatives in this strange country. And the Carnivores will be perhaps more fairly excluded altogether from the Australian series, since the solitary member of this group is the semi-domesticated Dingo, hardly to be ranked as a wild species. Quadrumana, Insec-

tivora, Edentata, Pachydermata, and the great order of Ruminantia, for which its fine grassy plains would appear, and as we know by experience *are*, well adapted, are alike unknown to Australia in a state of nature. But let us see a little more narrowly of what the Placental series of Australian Mammals does consist.

The Rodents of Australia, although, as we are informed by Mr. Gould, "numerous in species, and almost multitudinous in individuals," are certainly not well developed as regards generic forms, being only represented by three genera of the family Muridæ. These are the cosmopolitan *Mus* and two forms peculiar to the country, *Hydromys* and *Hapalotis*, of which three genera, altogether nearly thirty species, are found in Australia.

Of the Bats of Australia, we can hardly say that enough is yet known to allow of deductions being drawn as to the presence or absence of peculiar forms. Mr. Gould has figured twenty-three species of this order in his great work. Four of these belong to the fruit-eating family Pteropodidæ, so extensively diffused throughout the Indian Archipelago, and are, perhaps, of comparatively recent introduction into the Australian Fauna. The Insectivorous families of the Chiroptera are represented by four genera, but it is a noticeable fact that but one of them (*Nyctophilus*) is a form peculiar to Australia; the other three, *Molossus*, *Rhinolophus*, and *Taphozous*, being genera of wide distribution.

The Carnivora, as I have already stated, are only represented in Australia by the semi-domesticated Dingo (*Canis dingo*).

The subjoined table will serve to show at a glance, the results we have thus arrived at concerning the Australian Mammal-fauna.

Terrestrial Mammals of Australia.

Order.	Family.	No. of Species.
	IMPLACENTALS.	
Monotremata	Ornithorhynchidæ	1
	Echidnidæ	2
Marsupialia	Macropodidæ	49
	Phascolomyidæ	4
	Phalangistidæ	19
	Peramelidæ	8
	Dasyuridæ	24
		107
	PLACENTALS.	
Rodentia	Muridæ	29
Chiroptera	Pteropodidæ	4
	Rhinolophidæ	3
	Noctilionidæ	1
	Vespertilionidæ	15
Carnivora	Canidæ	1
		53

In conclusion, the peculiarities of the Australian Mammal-fauna, which distinguish it in the most marked way from that of every other part of the world may, I think, be put as follows:—

1. The presence of the only known members of the bird-like Order Monotremata.

2. The great prevalence of Marsupials, two-thirds of the whole of the known Mammals of Australia belonging to the single order.

3. The absence of all Placental Mammals, except Rodents, Bats, and a single Carnivore.

EXPLANATION OF THE ILLUSTRATION.

Mr. Wolf's plate represents a moonlight scene on the verge of an Australian forest. In the foreground, facing the observer, to the left is a Wombat (*Phascolomys lasiorhinus*); to the right an Echidna (*E. hystrix*). In the open background are some Kangaroos (*Macropus major*). A Koala, or "Native Bear" (*Phascolarctos cinereus*), is slowly climbing a tree, on the branches of which a group of Phalangers (*Petauri*) and Tarsipes are disporting themselves, whilst a large Flying Phalanger (*Petaurus taguanoides*) is crossing the open space in full flight to the base of an adjoining tree.

THE HISTORY OF THE BRITISH COAL MEASURES;

Being an Account of the Range and Distribution of the Coal Formations beneath the more Recent Strata of the Central and Southern Counties of England.

By EDWARD HULL, B.A., F.G.S., &c.

ON a former occasion* I ventured to give a condensed description of the several coal-fields of Great Britain, along with an estimate of the mineral resources of each; and I then endeavoured to show that several of the principal coal-fields of the central counties of England are not to be regarded as independent, or self-contained, tracts of coal-bearing strata, but are in reality the uncovered portions of a formerly continuous sheet of these rocks, the greater part of which is now overspread by formations of more recent age. To the reader who is not thoroughly versed in the physical geology of our island, the general arrangement of these various formations may be rendered more intelligible by regarding for a moment the coal-fields as islands rising from a sea of the newer strata. Like most similitudes, however, this one does not bear to be carried too far, for while all land-surfaces (islands as well as continents) are connected under the ocean, some of our coal-tracts (as I shall endeavour to show) were originally dissevered from others by intervening barriers of Siluro-Cambrian lands.

The determination of the question regarding the nature and age of the strata which underlie those wide undulating tracts of red marls,

* 'Quarterly Journal of Science,' vol. i. p. 24.

sandstones, and conglomerates which go to form the Triassic and Permian formations of the central counties, as also the Liassic, Oolitic, and Cretaceous groups of the eastern and southern counties, is one of the most interesting problems which it is the province of the geologist to solve. It is, in fact, a compound problem, embracing several questions concerning the physical geography of our island before, during, and after the formation of the coal-measures* themselves. It was once supposed that all the formations from the coal-measures upwards succeeded each other with such regularity and persistency, that whenever one group was found at the surface all the earlier groups were certain to occur beneath. More recent observations, however, have tended to dispel this illusion, and to show that the Carboniferous rocks have been deposited over certain ever-widening depressions more or less bounded by tracts of land which never were submerged during the whole period; and that as regards the Carboniferous groups themselves, and those which succeed them, they are to be regarded *not* as a series of heterogeneous strata deposited without plan, in some places more thickly than in others, without the possibility of determining where the thickness may be greater or less, but as a series of wedge-shaped layers lying one over the other along certain well-determined bearings of the compass. These conclusions lead us to note some remarkable coincidences in the physical geology of Great Britain, upon which we shall touch at the conclusion of this paper.

The subject naturally divides itself into four heads:—

1. Nature of the floor over which the Carboniferous strata were originally spread.
2. The distribution of the Carboniferous strata themselves.
3. The distribution of the formations which overlie the Carboniferous strata.
4. The mutual relationship of these formations, and their teachings.

In treating on these subjects I shall avail myself of the views expressed by several writers on the physical geology of our islands, to whom once for all I beg to express my acknowledgments.†

1. *The Nature of the Floor and Original Margin of the Carboniferous Strata.*

The rocks which precede in point of time the Carboniferous are referable to three great systems—the Cambrian, Silurian, and Devonian; and it would seem that at the close of each of the last-named periods in the north of England and Wales, the rocks were upheaved into islands, or it may be into land which was continuous over the

* The term "coal-measures" is that generally used to denote the upper Carboniferous rocks which contain the principal beds of coal in England; they consist principally of shales, clays, and sandstones of various kinds formed in the sea.

† Amongst others I would specially refer to Professor Phillips ('Geology of Yorkshire'); Professor Sedgwick ("Memoirs on the Formations of the North of England," 'Geological Transactions'); Mr. Jukes ('Memoir on the South Staffordshire Coal-field'); Mr. Godwin-Austen ('Quarterly Journ. Geol. Soc.,' vol. xi.). Some of the points in this paper have been treated of by myself more fully than space will allow of here, in two Memoirs in the 'Journ. Geol. Soc.,' vols. xvi. and xviii.

present bed of the Irish Sea, extending into Ireland and the Atlantic. The unconformable position in which the beds of Old Red Sandstone rest on the Silurian formations in these parts, conclusively proves the date of these great movements. In South Wales, however, the Carboniferous beds succeed the Devonian in a nearly regular sequence, and there does not appear to have been the same amount of disturbance and denudation as in the north. The result is, that in the north of England and Wales the floor of the Carboniferous beds is formed for the most part of Cambro-Silurian rocks; in the south, of Devonian.

If we extend our inquiries into the central and eastern counties of England, we pass into a region where actual observation has, for the most part, to give place to deduction. The points where the Pre-Carboniferous rocks are brought into view are few and far between, but by observing the changes which the coal-measures undergo on approaching these landmarks (as we may be allowed to call them), and endeavouring to find the connection of these points with each other, we have, I think, sufficient data for reasonable conclusions on the subject. Now whenever these Pre-Carboniferous rocks show themselves, whether rising from beneath the coal-measures, the Triassic, or later formations, they are found to belong either to the Cambrian or Silurian systems, never to the Devonian; we may therefore conclude that the floor of the Carboniferous rocks over this area is, for the most part, if not altogether, composed of Cambro-Silurian beds.

Having thus determined the nature of the floor over which the Carboniferous strata were deposited, let us now endeavour to trace the original margin of the coal-formation as indicated by the uprising of the older rocks at various points.

The most conspicuous uprising of these beds in the heart of England is in Charnwood Forest, Leicestershire. The Cambrian rocks are here brought up on the east of the coal-field by a fault, but this only hastens their natural appearance, as forming the original margin of the coal-measures in that direction. There are several other spots farther to the east where bosses of trap, apparently of the age of the Charnwood Forest rocks, reach the surface through the red marls of the Trias, indicating the total absence of the coal-measures. From these points, if we trace the boundaries of the coal-fields of the Midland Counties through Warwickshire, South Staffordshire, Worcestershire, and Shropshire into North Wales, we shall find frequent evidences of the proximity or actual appearance of a ridge or barrier of land which, I believe, formed the margin of the Carboniferous area across the centre of England. Space will not admit of detailed reference to each of the spots where the old rocks reach the surface. They occur near Atherstone, west of Birmingham, and at the Licky Ridge north of Bromsgrove. In these spots the rocks are of Cambro-Silurian age. In Shropshire, however, as at Bridgenorth, the Devonian formation appears, having originally formed in some places the margin of the Carboniferous area. The Silurian rocks, however, predominate, and furnish the margin at Wellington, Shrewsbury, and along the banks of the Severn into North Wales. The spots here indicated do not lie

in a regularly curved line, but as it were in a series of promontories jutting northward from the mainland, which we may call "The Barrier." (*See map.*) The northern margin appears to have been irregular in outline, frequently indented with bays, in which tracts of coal-measures were formed, such as the coal-fields of the Forest of Wyre and of Warwickshire. In some places only the very uppermost beds were formed, the land not having been submerged till towards the close of the period. This barrier of land is shown on the accompanying map, crossing the centre of England in a narrow and indented band.

The southern margin of the barrier can only be very roughly determined. The northern limits of the great coal-tract of South Wales must have extended far beyond its present bounds, and the same may be said in a lesser degree of the coal-fields of the Forest of Dean and Somersetshire. It is therefore probable that the greater part of the slaty region of South Wales was once covered by beds of coal, and that along the valley of the Severn the barrier was extremely narrow at the close of the Carboniferous period. Mr. Godwin-Austen has shown the probability that a band of coal-measures originally stretched across the south of England from Somersetshire into France and Belgium. That this band did not stretch far to the north of the estuary of the Thames there is reason for concluding, from the results of the boring experiments at Harwich. Here cleaved slaty rock of Silurian or Cambrian age was reached beneath the Cretaceous beds, without a trace of the intervening formations. We may well believe that this slaty rock forms but a part of the tract of ancient land which stretches under the Eastern Counties, and of which the rocks of Charnwood Forest formed the margin towards the north-west.

From the above observations it will be seen that the coal-measures of England formed originally two separate areas, one lying to the north, the other to the south, of The Barrier, as indicated in the map. These have subsequently been broken up and formed into separate "coal-fields," which may be thus arranged :—

Coal-fields North of The Barrier.—North Wales, Forest of Wyre, North Staffordshire, South Staffordshire, Warwickshire, Leicestershire, Derbyshire, and Yorkshire, Northumberland, Durham, and Cumberland.

Coal-fields South of The Barrier.—South Wales, Somersetshire, Forest of Dean, and supposed band along the Thames valley.

The coal-fields of the central valley of Scotland were probably connected with those of the north of England, round the eastern coast, but space does not admit of further reference to them on this occasion.

2. *The Distribution of the Carboniferous Strata themselves.*

There are three main causes tending to increase or lessen the thickness of any group of strata at special points of its area during deposition. First, the sediment may be deposited over a deep-sea bed, or a shelving shore; secondly, the sediment deposited may be near or

at a distance from the source of supply; and thirdly, the velocity of the current may be great or small, the transporting power of which is as the sixth power of the velocity. Observations on the accumulated thickness of strata or groups are instructive, as tending to throw light on these questions, but the subject regarded in this light has not received its due share of attention. Classifying the strata which compose the Carboniferous group into Calcareous and Sedimentary,* and confining our attention to the latter, we can compare the relative thickness of these beds with their representatives in various parts of the country, and in so doing arrive at some very interesting results, for we find the thickness changing according to a definite plan or arrangement. On the north side of The Barrier we find a constant diminution in the vertical thickness of the group on proceeding from north to south, while on the south side of The Barrier the decrease takes place from west to east, showing a change of physical conditions, and the marked influence which this dividing ridge has exerted upon the distribution of the sedimentary materials.† Supposing the velocity of the currents which have transported the sand and clays of the coal-measures to have been the same on both sides of The Barrier, we may conclude that the thinning of the beds arises from the two first causes above stated, namely, the approach to a shelving shore and the diminishing supply of sediment as the distance from the sources of supply increases. It would therefore appear that north of The Barrier the source of supply lay to the north; and south of The Barrier the source lay to the westward. These sources must have been lands traversed by rivers, bringing down sand and mud which the currents of the sea took up and distributed over the ocean bed.‡

As illustrations of the thinning away of the beds on either side of The Barrier from north to south in one case, and from west to east in the other, let us take the following from districts lying in nearly direct lines in each case, which have been very carefully measured during the progress of the Geological Survey.

NORTH OF THE BARRIER.

	Lancashire. Feet.	North Staffordshire. Feet.	Leicestershire. Feet.
Upper Coal-measures	2,000	1,000	2,000
Middle "	3,500	4,000	
Lower "	1,800	1,000	1,000
Millstone Grit	3,500	500	50
Yoredale Beds	2,000	2,300	50
	12,800	8,800	3,100

* That is, limestones on the one hand, and sandstones, clays, shales, &c., on the other.

† I take for granted that all my readers admit that the *sedimentary strata* have been deposited from sands, mud, &c., held in suspension by the sea and carried by currents.

‡ The depth of shading on the map will indicate what may be considered the deep and shallow parts of the submerged areas.

SOUTH OF THE BARRIER.

	Glamorganshire.	Forest of Dean, Gloucestershire.
	Feet.	Feet.
Coal-measures . . .	11,650	2,765
Millstone Grit . . .	3 0	455
	11,980	3,210

From the above examples it will be observed that between Lancashire and Leicestershire there is a falling off, in a distance of about seventy miles, of about 10,000 feet of strata, and between Glamorganshire and Gloucestershire, in a distance of about fifty miles, a falling off of about 8,000 feet. Similar results might be obtained by comparisons along parallel lines of country.

The question may now be asked, "What does this prove?" The answer, I think, is plain; it proves the gradual dying out of the coal-formation towards the Eastern Counties, and affords grounds for the belief that even if there had existed no barrier of land in this part of England, the formation would have failed to extend itself under the Cretaceous districts. The Barrier has, however, formed the termination of the northern coal-area towards the south-east, as well as of the southern coal-area towards the north-east, in both instances more abruptly than would have resulted from the mere thinning out of the beds; on these grounds I have left unshaded the part of the map forming the Eastern Counties.*

3. *The Distribution of the Formations overlying the Carboniferous.*

We now approach the third topic of our inquiry, and in doing so shall limit ourselves to the Permian, Triassic,† and Jurassic‡ formations. The lowest member of the Permian formation (the *Rothe-todtliegende*) is extremely variable, and seems to have been deposited in a depression formed in the Carboniferous beds of which Warwickshire may be considered the centre. Here it reaches a thickness of 2,000 feet, and thins away from this centre in every direction. The upper member, or magnesian limestone, is for the most part confined to the north-east of England. Coal may be considered as within workable reach whenever it occurs under the Permian formation, provided this latter forms the surface of the ground, and the depth will not exceed 1,000 yards.

When we come, however, to consider the distribution of the formations which succeed the Permian, we cannot but be struck with the regularity of the plan upon which they have been formed. We have already seen the manner in which the Carboniferous strata increase and decrease in certain directions. Now it has been found, on comparing a series of carefully-measured sections and tracing the subdivisions of the Triassic group, that they undergo a like decrease in

* I may again refer to the Harwich boring, which in a remarkable degree corroborates the above inferences.

† *Triassic*—comprehending new red sandstone and marl.

‡ *Jurassic*—those of the lias and oolite.

thickness from the north-west towards the south-east of England, so that a series of lines, each representing a certain thickness of beds wherever drawn, would be found to cross the country obliquely from south-west to north-east.* The Trias attains its greatest vertical development in Lancashire, and from this gradually thins away towards Warwickshire; so that while in the former county the thickness may be placed at nearly 5,000 feet, in the latter it is only 600 where it passes below the Lias. Here we lose all sight of it, but judging from analogy, we may conclude that it thins away altogether somewhere about the line of the chalk escarpment; and we know from actual experiments that it does not reach the sea at Harwich.

By a series of similar comparisons we find that the Lias undergoes a similar change in thickness, dying off towards the south-east; and there is reason to believe that the succeeding clayey beds of the oolitic groups prove no exception to the rule. Now as these formations, owing to denudation,† terminate abruptly in the direction of their maximum of thickness, in other words, towards the north-west, we may regard them as a series of great wedges lying over each other in succession, with their thin edges directed towards the south-east coast, but never actually reaching so far.

The view here adopted of the close proximity of the ancient Cambro-Silurian rocks beneath the Cretaceous in the south-east of England receives confirmation from certain characteristics of this latter group itself. Conglomerates, consisting of black hornstone, slate, and quartz, are not uncommon; and in the notable sinking made in search of water at Kentish Town, near London, a conglomerate of syenite, greenstone, porphyry, quartz, and schistose pebbles was reached at a depth of 1,122 feet from the surface. These pebbles being the *detritus* of subaërial rocks in the neighbourhood of the strata which were being formed over the bed of the sea at the commencement of the Cretaceous period, seem to indicate the total absence of the softer strata of the later Palæozoic and earlier Mesozoic periods.

4. *The Mutual Relationship of these Formations, and their Teachings.*

From the above considerations it will be apparent that while the coal-formation attained its greatest development in the north of England, the formations which overlie it also attained their greatest vertical dimensions in nearly the same direction; and since the coal-measures are brought to the surface in Lancashire, Staffordshire, and North Wales, it follows that the elevating forces and the agencies of denudation have acted with greatest effect over these parts, that is to say—*looking at the beneficial results*—where most needed. How impenetrable would have been the covering which once overspread the coal-measures of the north-west of England may be judged by estimating the thickness of the strata which we may infer formerly covered

* Such lines I have traced for the Carboniferous group under the term "isometric lines." See 'Quart. Journ. Geol. Soc.,' vol. xviii. p. 127.

† "Denudation" is a term used to express the sweeping away by the sea, rivers, &c., of portions of the strata.

the Lancashire coal-field to a depth of 7,000 feet, distributed as follows :—

	Feet.
Jurassic Strata	1,600
Triassic „	4,750
Permian „	650
	7,000

This enormous amount of material which buried the precious deposits of mineral fuel has been swept away, and the north-western coal-fields have been brought to light. In the Central Counties little more than half this amount needed removal in order to disclose the coal-fields of those districts; further east the amount was still less, but *there* we approach the margin of the original coal-tract itself. We arrive, therefore, at this conclusion—that Nature put forth her greatest efforts when there was work to be done for a certain beneficial end; in other words, the utilization of the mineral fuel which had been stored up for countless ages beforehand.

Now let us for a moment reverse the picture. We can easily conceive the elevating forces which have upheaved the formations towards the north-west, acting in such a manner as to have upheaved the formations from the south-east. As far as we can see, there is no physical cause why the one should have taken place in preference to the other. In such a case what would have been the result as regards ourselves, our commerce, our position as a nation? It has been shown with a certainty only short of demonstration that there is no coal under the Eastern Counties, and that the coal of the Western has once been placed at inaccessible depths by enormous accumulations of more recent strata. If, therefore, the upheaval and denudation had taken place from the south-east, it is perfectly clear that the coal-fields of the North-west and Central Counties would have remained buried at unapproachable depths; and in the east of England, a region composed of granitoid or slaty rocks would have been brought to light; in a word, we should have had a region in Suffolk such as North Wales, and one resembling Cambridgeshire in Lancashire.

But we cannot shut our eyes to the fact that however large the areas of coal which Providence has placed within our reach, still larger areas are concealed to view, and an extent of coal-ground equalling the whole of that now remaining, whether at the surface or below it, has been entirely swept away. If we compare the extent of the original coal-formation, as shown on the map which accompanies this paper, with that given in the first Number of this Journal showing the actual coal-areas, we shall be struck with this fact. Nature in this case, while operating for the future benefit of the patient, has not neglected to make use of the knife; but as it is better for a patient to lose a limb in order to save his life, so we have no right to complain if our present extent of coal-surface has been secured at the sacrifice of even a large part of the original area.

MAP
Shewing the Area of the
COAL-FORMATION
At the Close of the
CARBONIFEROUS PERIOD.
The shaded portions shew where the Coal-Formation originally extended.
The unshaded portions were Land Surfaces during the Coal Period.
Perth
Edinburgh
Glasgow
Newcastle
Kendal
York
Manchester
Lincoln
Bala
THE BARRIER
Leicester
Worcester
Harwich
Devon
Swansea
London
Bristol
Dover

ON THE CAUSES OF BRITAIN'S GREATNESS.

A Review of the Relations of her Geology and Geography to her History.

By W. PENGELLY, F.R.S., F.G.S.

A FORMAL attempt to prove that Britain is pre-eminent amongst the nations, whether ancient or modern, for manufactures and commerce, would be a work of supererogation. The proposition is firmly believed by ourselves, and admitted by our neighbours.

It may not be uninteresting, however, to throw into a readable form a few of the huge numbers employed by the statistician to show the greatness of our commercial transactions. A glance at our import and export tables reveals not only the magnitude of our undertakings, but also our national character and position. Our imports are mainly food and raw materials; our exports chiefly manufactured goods. We see a teeming, industrious artisan population occupying a country which does not grow food sufficient for them.

In 1860 we exported cotton goods to the value of over fifty-two millions sterling; the cotton cloth alone amounted to more than two thousand seven hundred and seventy-five millions of yards, that is to say, to more than one million and a half of miles, or more than sufficient to reach from the earth to the moon six times and a half. Had the price of this cloth been increased by one farthing per yard only, the sum thereby produced would be upwards of two millions eight hundred and ninety thousand pounds sterling, or one hundred pounds per annum for nearly thirty thousand families. Invested at three per cent., it would produce an annual dividend of nearly eighty-seven thousand pounds, or sufficient to give constant employment to two thousand two hundred and thirty labourers at half-a-crown per day each. The fact that, in consequence of the unhappy American war, our exports of cotton cloth sank in 1862 by upwards of one thousand million yards, shows how dependent we are on foreign countries; and our continued national prosperity, notwithstanding the cotton famine, shows also the greatness of our other manufacturing industries.

Omitting upwards of three hundred and sixty thousand tons of flour and meal, we imported in 1862 sixteen millions of quarters of corn, or sufficient to build a wall thirteen inches thick, twenty feet high, and one thousand four hundred and sixty miles long, that is, the perimeter of the triangle of which the Land's End, the North Foreland, and Dunnet Head are the angular points; in other words, to build a wall entirely around Great Britain. In the same year we received from foreign lands upwards of four hundred and fifteen thousand live animals, or one thousand one hundred and thirty-eight every day throughout the year; besides more than two hundred thousand tons of animal food, as bacon, &c.

The machinery used in our carrying trade is, of course, on a scale commensurate with the trade itself. In 1862 we employed in our foreign and coasting trade four hundred and twenty-four thousand ships, having an aggregate tonnage of sixty-one millions six hundred

thousand tons. On the average throughout the year, nearly fifty vessels left a British port every hour, each carrying one hundred and forty-five tons.

The total length of railway open for traffic in the United Kingdom at the end of the year just mentioned, was upwards of eleven thousand five hundred miles, at a cost of very nearly three hundred and eighty-five and a quarter millions sterling.

In the same year the post-offices of the United Kingdom delivered six hundred and five millions four hundred and seventy-one thousand letters, seventy-three million newspapers, and fourteen million book parcels. Had the letters been placed in ordinary envelopes—about four inches and three-quarters in length—these placed end to end, would form a straight line nearly forty-five thousand four hundred miles in length. Assuming each person on the post-office staff to be an adult male and the head of a family of five persons, the entire establishment represents a population larger than that of Herefordshire, larger than the joint population of Huntingdon and Westmoreland, and nearly six times that of Rutland.

The wealth which our manufacturing and commercial activity brings us, is seen in the luxuries in which we indulge.

If the tobacco consumed in the United Kingdom in 1862 had been made into cigars and packed in one-pound boxes of the ordinary dimensions, they would have formed a wall, one box thick, twenty-four boxes or ten feet three inches high, and over two hundred and fifteen miles long; that is, more than the length of the railroad from Paddington to Newton Bushel in Devonshire. It is frequently said, "that few men smoke a dry pipe," and the following figures will show that the saying appears to rest on a basis of fact. We paid duty for home consumption in 1862, on upwards of three hundred and seventy-three millions of gallons of wines, British and foreign spirits, and malt liquors; in other words, our alcoholic beverages for one year—exclusive of cider, perry, home-brewed beer, British wines, and smuggled goods—would fill a canal three feet deep, six feet wide, and six hundred and forty miles long; that is, forty miles in excess of the distance from the Land's End to John O'Groats!

The commercial activity, and the consequent wealth of Great Britain are portions of history, and must be regarded as such, even if they were isolated facts; but it cannot be forgotten, that the occupations of a people affect their mental development, and, consequently, their institutions; the artisan is, without doubt, more intelligent than the farm labourer; whatever, therefore, stimulates the manufactures of a nation tends to render the working classes more intellectual and more important socially and politically, and thus to foster the growth of popular institutions.

Now, though it is certain that some of our waste lands may be reclaimed, and possible, perhaps, that additions may be made in other ways to our cultivated acreage, it is highly improbable that the growth of area can keep pace with the growth of population; there is a limit perhaps to each, but that of the former will certainly be reached long before we approximate that of the latter. The population of England

and Wales in 1801 was something over nine millions, in 1861 it was nearly twenty and a quarter millions, the increase being more than one hundred and twenty per cent.; at the former period there were one hundred and fifty-eight persons to the square mile, at the latter there were three hundred and fifty.

In 1861 the population appears to have been thus composed:—In every thousand persons, there were twenty-four belonging to the professional class, five hundred and seventy-four to the domestic, thirty-one to the commercial, one hundred and one to the agricultural, two hundred and forty-two to the industrial ("comprising all our manufacturing community as well as those who follow the production of the material to work it up into almost infinite forms of utility and beauty"), and twenty-seven to the indefinite and non-productive;* so that at present the manufacturing alone, bears to the agricultural population the ratio of nearly five to two; and this ratio, in all probability, will increase, because the number of agriculturists will be related to the number of cultivatable acres (already nearly a maximum), not to the general population, which is rapidly increasing; and also because the mechanician, by new inventions and applications, is constantly displacing the farm labourer. The occupation of the masses as a whole, therefore, is steadily changing and in a definite direction, and this, as we have seen, cannot but be followed by a change in the character of the population; moreover it is, at least, relatively diminishing the class from which our armies have been very largely if not mainly recruited.

The accumulation of wealth, too, calls into being a new, a moneyed, —aristocracy, which, to some extent, is a counterpoise to the aristocracy of territory and of rank; and an auxiliary in the de-feudalization (if such a coinage be allowable) of our institutions.

The importance of foreign corn-fields and foreign markets to us, necessarily affects our international treaties, and, through them, the nations with which we come into contact; our true policy is peace and unrestricted trade.

But why is Britain thus great? Whence this pre-eminence? Are there any facts connected with her or her people which will account for the place she occupies? Anything which would have enabled a gifted man to predict her position amongst the nations? In reply, it may be asked, Is not her history the simple result of her structure and situation? Was it not pre-written in her geology and geography?

Let anyone take a common terrestrial globe, and so adjust it that the greatest possible amount of land shall be above, and the least below, the wooden horizon; that is to say, divide the world into two hemispheres, one terrestrial, the other oceanic; one the home of the nations, the other their common highway; and it will be found that the town of Falmouth in Cornwall—and hence we may say Britain—occupies the *centre* of the first; she has the best possible position for the market-place of the world, since her dealers dwell around her on every side. Geologists tell us that their science discloses the fact

* 'Companion to British Almanac, 1862.'

that the distribution of land and water has frequently and greatly varied. At present, rather more than three-fourths of the earth's surface are occupied with water, and something less than one-fourth with dry land; but were it proved that this has been a constant ratio, it by no means follows, nor is it probable, that about three-fourths of the land have always been in the northern hemisphere, nor that twenty-six square miles of dry land out of every twenty-seven have at all times, as now, had water at their antipodes. A slight change in the grouping, and the centre, instead of being in Britain, might be shifted far into some continental mass; say, for example, to Timbuctoo. The bare supposition shows that we enjoy the advantage of *insularity* also.

Now this insular position secures to us numerous advantages, and amongst them that of *accessibility;* it would have availed us little to have occupied an inaccessible centre. But whilst it facilitates communication between our customers and ourselves, it renders us *comparatively free from invasion;* it is less easy to land a hostile force than to march it from one continental country to another. It brings with it also a *large amount of coast;* the civilization of the great divisions of the earth is pretty clearly indicated in the relation of their coast-lines to their respective areas; thus Europe has one mile of coast for every one hundred and fifty-six square miles of surface; North America, one for every two hundred and twenty-eight square miles; South America, one for every three hundred and seventy-six; Asia, one for four hundred and fifty-nine; and Africa, one for six hundred and twenty-three;* or, to throw the same facts into another form, for every ten thousand miles of surface, Europe has sixty-four miles of coast; North America, forty-four; South America, twenty-seven; Asia, twenty-two; and Africa, sixteen; or, again, to give them still another aspect, if we put the relative coast-line of Europe at one hundred, that of North America is sixty-nine; South America, forty-one; Asia, thirty-four; and Africa, twenty-five. It is worthy of remark, too, that a portion of the coast-lines of Europe, Asia, and North America is almost useless as a sea-bord, from its Arctic position. Europe, however, is deprived of comparatively little in this respect; the losses on this account being, for the three divisions respectively, as the numbers nine, fifteen, and twenty.

Now amongst the countries of favoured Europe, the British Islands—and especially Ireland—are, on the whole, the most richly supplied in this respect. Great Britain has one mile of coast for every fifty-seven square miles of area, being about three times greater than that of France and of Europe generally.

The coast advantages possessed by an insular over a continental area are, of course, greatest in small islands. Suppose, for example, two square islands to be—one a mile in length and in breadth, the other two miles long and two broad, their areas are one and four square miles, their coasts four and eight miles respectively; the first has four, the second only two, miles of coast for every square mile of surface. In short the relative coast decreases in the same ratio as the side of

* Guyot's 'Earth and Man,' 1850, p. 39, &c.

the square increases. A small island, however, is incapable of a large population, the nation inhabiting it can never be sufficiently numerous to be very powerful. Now, Britain is *large enough* to sustain a nation capable of commanding respect, yet *small enough* to secure a larger relative coast-line than any other country in Europe.

An island has also the great advantage of *comparative equability of climate.* The sea is less liable than the land to fluctuations of temperature; on several accounts it is cooler than the latter in summer, and warmer in the winter; hence the breezes which blow from it throughout the year are more equable than those coming from the land. Now, excepting those of a very local character, no wind passing over an island of moderate dimensions can fail to be charged with marine influences. Severe as a northerly or north-easterly wind may sometimes be in a British spring, its severity would be unquestionably greater, and we should be less able to bear it, but for the sea with which our island is engirt.

Again, our position is *near the middle of one of the temperate zones.* Had it been within or very near the torrid zone on the one hand, or the frigid on the other, any advantages connected with our situation in other respects would have been greatly impaired. If one may so speak, our energies would have evaporated in the first case, or frozen in the second. "A hot climate," says the late Professor Waitz, "renders physical, and still more mental, labour difficult, induces man to consider every kind of effort as a greater evil, and indolence a greater enjoyment than is the case in temperate or cold regions."* The temperature, however, in our latitudes is not only compatible with labour throughout the year, but may be said to compel it; exercise, another name for work, being essential to the maintenance of health.

Omitting the ellipticity of the earth's orbit and the phenomenon of twilight, the year is everywhere equally divided between light and darkness; but though this law obtains throughout the world, its incidence is variable and depends on the latitude of the place; the greater the latitude the greater the inequality of longest and shortest days, but everywhere the excess of the first, over twelve hours, is always balanced by the defect of the second. Now, taking Greenwich as representing the British Islands, *our longest day is about sixteen hours and a half, and the shortest seven and a half,* that is, from sunrise to sunset; hence when most curtailed the day falls but little below the time in which an industrious man can expend his energies. A few degrees farther North would bring much shorter winter days as well as a severe climate, and a corresponding removal Southwards would introduce a climate unsuited to an energetic race.

The length of day and night, moreover, is of importance in other respects. The acquisition of heat depends very largely on the former, and the loss of it, through radiation, on the latter. In higher latitudes less heat is received, and more lost, during the winter than with us, and the reverse obtains in the summer; the total effect being to augment the difference between the summer and winter temperatures,

* 'Anthropology,' p. 330.

in fact, to produce an extreme rather than an equable climate, a thermal condition more trying to the health than perhaps any other.

Nor should it be forgotten that, on account of the elliptical form of the earth's orbit, the proximity of the perihelion to the winter solstice, the greater amount of land on the Northern than on the Southern side of the equator, and sundry other circumstances into which it is unnecessary to enter here, the temperature of the Northern hemisphere is less extreme in its fluctuations, and on the average is higher than that of the Southern.

There is an advantage, too, in our being on the *eastern* side of the Atlantic. A line drawn round the earth, through all places having the same mean annual temperature, is termed an *isotherm*. Now, lines of this character, instead of coinciding with parallels of latitude, undergo remarkable deflections; for example, the isotherm of 50° Fahr. passes from the Pacific to the continent of Asia in about latitude 42½ N.; it gradually creeps up to 47½ N. between the Aral and Caspian Seas, whence it ascends more rapidly, and enters the German Ocean in about 53° N.; it reaches its highest point in the British Isles, where it touches the parallel of 54° N.; after this it bends southward, until, on entering the American continent, it almost reaches the low latitude of 40° N. In its course across America, its deflection, on the whole, is northerly; and on the eastern side of the Pacific it culminates a second time in 54° N.; after which it bends southwards, and reaches 41½° N., in the Japan Archipelago. In general terms, then, the greatest northern deflections occur on the eastern, and the greatest southern deflections on the western, sides of the two oceans, and this is true of all the isothermal lines north of the tropic of Cancer; so that the eastern sides of the Atlantic and Pacific Oceans are warmer, and the western colder, than is due to latitude merely. In the example traced above, the mean annual temperature of Britain is the same as that of a place fourteen degrees farther south on the opposite side of the Atlantic.

But whence this difference?

Enormous bodies of water move through the ocean in constant and definite directions; some of them from tropical regions towards the poles, others from cold latitudes towards the equator. The rotation of the earth on its axis causes every place to move eastward more rapidly than those more distant from the equator; hence all poleward currents are continually reaching districts moving eastward less rapidly than themselves, and thus outstrip them, or move by them eastward. The reverse of all this obtains in the case of currents from high to low latitudes; relatively, to the parts of the earth they successively reach they move westward; more correctly, less rapidly eastward. In fine, warm currents moving towards the poles impinge on the eastern shores of the oceans to which they belong, and cold currents proceeding towards the equator fall on the western shores. Amongst the great currents of the Atlantic the most celebrated is the Gulf Stream, which, from Cape Florida, pursues a north-easterly course, takes the British Isles in its journey, and, according to Scoresby, even reaches Spitzbergen. Britain is bene-

fited by it both directly and indirectly; directly, by the warmth which it brings us, which, according to Mr. Hopkins, raises the temperature of Snowdon (taken as representing the mean of England) by fifteen degrees of Fahrenheit during the month of January, and our mean annual temperature by half as much; indirectly, by strangling at the beach the glaciers formed in the valleys of Spitzbergen, and which were about to start, as icebergs, to chill the waters washing our northern coasts. Here, then, is a cause for the great northward deflection of the isotherms traversing the north-eastern portion of the Atlantic, and to it may be added the fact that Europe, of the three great northern divisions of the earth, extends least into the frigid polar regions. The lower temperature of the Atlantic sea-bord of North America is due to more than the negative fact that it is not visited by any body of heated water; it is mainly attributable to a current moving southwards from Baffin's Bay, which not only consists of water of low temperature due to its arctic origin, but transports vast fleets of icebergs. Sir John Ross saw several of them in Baffin's Bay, aground in water 1,500 feet deep; that is, fully five times deeper than the English Channel, even between Brest and the Land's End. It is stated by Sir Charles Lyell that the thawing of icebergs, as they drift southward, has been known to cool the water sensibly for fifty miles around, and sometimes as much as eighteen degrees in their immediate neighbourhood. Occasionally a large number are stranded on the west coast of Iceland, where they cause a failure of the crops by the fogs they incessantly generate, and drive the fish from the coasts by the reduction of the temperature of the water.

The British islands are, on the whole, well supplied with harbours and roadsteads. Should the era of large merchantmen, predicted by the 'Great Eastern,' ever be realized, the safe and capacious Milford Haven will be found to occupy a prominent place in the history of our commercial marine.

None of our numerous rivers, of dimensions available for inland navigation, are obstructed by rapids or waterfalls; it is scarcely possible, however, to study the gorges through which some of them pass without being convinced that, in fierce and long-continued conflict with the rocks which bound them, they have won the channels they occupy. We are taken back to a remotely distant time when some of our streams fell helplessly over opposing ledges; we see the fall slowly dwindle into a rapid, and this in its turn give place to a river of tranquil flow.

How much, also, do we owe to our vast and varied *mineral wealth!* The metals of Britain influenced history before the dawn of modern civilization. The adventurous and enterprising spirit which led the early Phœnician to Cornwall in quest of the tin it contained, was no doubt thereby fostered and developed, as well as transfused into the ancient Cornubii. Our mineral produce in 1862 was worth more than thirty-four and a half millions sterling; of this vast sum the value of the coals was considerably over twenty millions, and of the iron nearly ten millions. It has been said that "iron is the backbone of nineteenth-century civilization;" it may be added that coal is the

pabulum on which the giant feeds, and steam the fluid which circulates through his veins. It is believed that in 1863 our coal produce did not fall short of ninety millions of tons; that is, the freight of one hundred and eighty thousand ships, each carrying five hundred tons, or nearly five hundred such ships daily, or upwards of twenty every hour throughout the day and night. The importance of this enormous mass of fuel will, perhaps, be best estimated from the fact that it contained a mechanical power equal to upwards of thirteen years' labour, under the most favourable conditions, of thirty millions of able-bodied men—a number exceeding that of the entire population of the British Islands when the census was last taken.

These are among the salient facts connected with the situation and structure of our country, on which the position which she occupies amongst the nations largely depends. Britain is an island of desirable dimensions, rich in the amount and variety of her mineral wealth, and occupying the centre of what may be called the terrestrial hemisphere of the earth. She is well supplied with roadsteads, harbours, and navigable rivers,—is placed within the temperate zone, in the northern hemisphere, and on the eastern side of the Atlantic Ocean. It should be remarked that each of the above facts is independent of all the others. Centrality, for example, by no means necessarily secures a maritime situation, or insularity, or desirable dimensions, or mineral wealth, or harbours, or rivers, or a particular hemisphere, zone, or ocean, or the direction of genial ocean currents. Each is the result of geological operations of incalculable antiquity. The sea is constantly encroaching on the land in some places, and retreating from it in others; and though such changes are in a lifetime appreciable by the initiated observer only, time alone is required to give them a value greater than any that can be assigned. The relative level of land and sea is by no means characterized by stability; for example, Sweden has long been undergoing a slow and gradual upheaval, and Western Greenland has been slowly sinking. A comparatively small elevation of Western Europe would deprive Britain of its insularity. Within its own borders many once-famous harbours have been completely silted up. The elevation of an island or the formation of a coral-reef between Florida and Cuba would rob us of the Gulf Stream.

Geologists tell us that in times geologically very recent, though humanly somewhat remote, our country underwent changes almost surpassing popular belief. They say that within our area the era immediately prior to the advent of man was so intensely cold, as to be appropriately termed "Glacial;" that this divided itself into three periods, of which the first and third were "continental," that is, the whole of the British area stood, at least, from five hundred to six hundred feet higher than now, so that the German Ocean and British Channels were left dry. The higher mountains of Wales and of Scotland were then occupied with glaciers. The second or intermediate period was one of submergence, by which, at least, the land north of the Thames and Bristol Channel, as well as that of Ireland, was carried down certainly fourteen hundred, and probably two thousand three hundred, feet below

the present level, and reduced to an archipelago of small islands This was a period of floating ice.

The position of a country, however, in the family of nations, is a product of which not only physical conditions, but human skill and industry are important factors; hence the question of race enters largely into the speculation; the subject has an ethnological aspect.

The different races into which the human family resolves itself are either the offspring of so many distinct original types, or the outcome of varied external conditions operating, through long periods of time, on the plastic descendants of one primal pair. On the first hypothesis, each original type must have come into being harmoniously related to the pre-existing physical characters of the district in which it was placed; and to this and similar districts its continued existence was necessarily limited. On the second, the race-characters are simply a reflex of the geology and geography of the area in which they were moulded as well as pre-written.

There can be no doubt that Britain and its Anglo-Saxon inhabitants are well adapted to each other. The energy and enterprise, characteristic of the latter, are not only necessary to the development of the resources of the former, but are fostered and fixed by the occupations pre-determined and necessitated by the physical conditions of the country. A district rich in minerals is valuable to an enterprising race only. A body of men can scarcely descend daily into the bowels of the earth, braving the dangers inseparable from such an employment, without being confirmed in any love of adventure which they may possess, and influencing the population of which they form a part. The coal miners of England number upwards of two hundred and forty thousand, and the metalliferous miners of Cornwall amount to very nearly thirty-one thousand, or upwards of one-twelfth of the entire population of the county. We can scarcely send this body of men—a total of more than a quarter of a million—underground daily, there to become familiar with danger in various forms, without being prepared to find in them and their offspring a character very unlike that of an agricultural population. Moreover, where, as in Cornwall, each miner is, in some shape, a partner in the undertaking; where he contracts to cut, at per fathom, rocks—sometimes granite, sometimes slate, sometimes elvan—varying much in hardness and in the possession of divisional planes; or where he is paid by a percentage on the proceeds; his prosperity depends on his observation, judgment, skill, and application. He may take as his motto—"Thought and Perseverance, or Starvation." An education of this kind not only makes him a skilful miner, but prompts him to carry his labour to the best market, even though he may find it at the antipodes. It is not surprising, therefore, that in whatever part of the world metals are found, there also are found Cornishmen engaged in extracting them.

Again, all other things being equal, a population will have maritime tendencies in proportion to the relative coast-line of their country; hence an unusually large percentage of the British nation are fishermen and sailors—that is to say, men familiarized with hardship and danger, and compelled to think; and this is probably true

of coasters and fishermen in a higher degree than of sailors who make long voyages, since the dangers and difficulties are much greater in the two first cases than in the last, both in proportion to the mileage and to the men who really have to encounter them. With a good ship and plenty of sea room a sailor has little to fear from any storm; moreover, the officers only (and in large ships they are few in proportion to the crews) address themselves to such difficulties as require thought. In small coasting, and especially fishing craft, where the crews frequently consist of two, and rarely of more than three or four, hands, every man is called upon to be a pilot; he must be acquainted with every rock and shoal, with the tidal phenomena of the district, with the indications of change of weather, and under the guidance of this knowledge he makes his voyage or selects his nightly fishing-ground; he becomes skilful in the management of craft, and adventurous in habit. And here, again, we may turn to Cornwall for illustration. Projecting farther than any other part of the island into the warm seas of the south and west, and possessed of a relative coast-line nearly twenty times that of even Great Britain as a whole—indeed, nearly twice that of any other English county—it is not surprising that her coasts swarm with seafaring men. The well-known dark-brown lug sail of the Mount's Bay fishing-boat is seen, not only in every part of the British Archipelago, but a few years ago a crew of six men, in one of these boats, undertook and performed the voyage to Australia, and that only for the purpose of fishing there. A gentleman, who knew the parties well, told the author of this paper that a fearful storm which they encountered in the Indian Ocean was duly chronicled in their well-kept log, and accompanied with the characteristic remark—"It would take a good ship to stand this storm, but our boat behaves admirably."

"A nation of shopkeepers" should be distinguished for integrity, and, though we may be sometimes compelled to regard commercial morality as an adulterated article, it remains to be a truth, well recognized by the British merchant, that "honesty is the best policy."

The genuine Englishman is also characterized by a love of independence and a resolution not to be content with the bare necessaries of life. "Potatoes and salt may keep body and soul together," but he expects the accompaniment of beef, which he would rather earn than permanently receive as a gift; he cannot afford to be lazy or improvident, hence he largely avails himself of Friendly, Provident, and Co-operative Societies, and Penny and other Savings-Banks. No doubt some of these schemes are ill-advised and prove to be failures, but this only serves to throw his providence into greater prominence, since successive disappointments of this kind have entirely failed to eradicate this trait of character. On November 20, 1862, the number of individual depositors, charitable institutions, and friendly societies in Savings-Banks was upwards of a million and a half, and their deposits amounted to more than forty and a half millions sterling. In the year just mentioned somewhat under six hundred thousand persons deposited very nearly one million nine hundred and fifty thousand pounds in the Post-Office Savings-Banks of the United

Kingdom. We have here the nucleus of many a future capital, and a material guarantee for good order.

Pecuniary prosperity is so firmly believed in by Englishmen, as to cause them to take what are called "Practical Views." Discoveries and inventions are prized in proportion as they can be shown to have a money value. Every new thought presented to the British mind is met with the question, "What good is it?" It is thrown on the counter of the money-changers, and received or rejected according as it has or has not a utilitarian ring. Though this trait must be regarded as a taint, it is inseparably connected with commercial activity and success.

The political institutions of a country are probably amongst the most faithful transcripts of the mind of the nation occupying it; and ours, whether logical or not, undoubtedly work admirably. No one abstains from sowing, because of any uncertainty as to his reaping and enjoying the harvest. The exiled chiefs of once rival parties may together enjoy our political hospitality without disturbing us, or even exciting attention. In more than a solitary instance, however, political refugees have brought us their arts and laid the foundation of important branches of trade.

Numerous questions and inferences, which suggest themselves in connection with the subject of this paper, must be omitted. The theme is a fertile one, and illustrations of its central idea abound in every country. *Our rocks are at once historical and prophetical.* They contain the wondrous history of their formation, of changes in the distribution of land and water, of the birth of mountains and rivers, of fluctuations in climate, and of the extinction of a vast and varied multitude of animals and vegetables which have successively occupied the earth. They also contain, in prophecy, the histories of unborn nations. Occupations, mental developments, institutions, lines of policy, are all pre-written within the rocks beneath us. The prediction may long wait a fulfilment, but it is none the less certain. Incalculable ages ago gold was deposited in Australian quartz. Incalculable ages since, then, a prediction was inscribed on the rocks of Australia, that sooner or later she would be favoured with an immense influx of civilized human beings from every part of the world, bringing with them their accomplishments, their industries, and their enterprise.

ON THE ORAL INSTRUCTION OF THE SO-CALLED DEAF AND DUMB.

Being some Account of the System of Tuition by "Lip-reading" and Articulation.

By GERARD VAN ASCH, Manchester * (late Teacher at the School for the Deaf and Dumb, Rotterdam).

THE articulation of the deaf and dumb is of such rare occurrence in this country that, to a casual observer, it might appear reasonable to think that all attempts to produce it must have been idle efforts without any result.

By many, dumbness is thought to arise from malformation of the vocal organs, or from some similar cause directly connected with these. But to those who have given this matter any consideration at all, it will need no second reflection to pronounce this a false notion. They will account for the affliction by the derangement or absence of certain parts of the internal ear, such as the auditory nerves, the drum, the chain of bones in the ear, &c., which disturbance prevents sounds from being perceived, and therefore from being imitated. The organs of speech in persons so afflicted present nothing peculiar; indeed, the deaf of tender age invariably exhibit a tendency to use them like hearing persons, and they imitate with pleasure directly they are shown the example and method of imitation. As their condition, however, admits only of their receiving a crude notion of vibration, the task of instruction is very difficult; for what comparison is there between the subtle nerves of hearing and those of touch, which form their only substitute? But difficulty does not imply impossibility; and a close study of the formation and variations of sounds, as they emanate from man's vocal organs, supplies a key of such value to the teacher of mutes, that it may serve him as an instrument to guide their endeavours to articulate, and to acquaint them practically with the principles on which the structure of our language is founded. The research will reveal many of those obstacles which it is needful for the deaf to overcome; it will disclose the elements that must serve as stepping-stones that will lead to the height, and will determine the course best calculated for them to follow.

Led by such knowledge, it is possible not merely to sift out easy consonants and vowels, and suitable combinations of these, but also words, and even sentences, which should be set apart for practice. In fact, by it may be determined whether one language is formed superior to another for the imitation of the deaf; and no doubt the English tongue must have presented greater difficulties to Wallis than the Dutch did to Amman, when these two simultaneously undertook the task of teaching articulation to some deaf children in England and

* This article is intentionally printed, with the most trifling alterations, in the words of the author, who has been in England five years, and knew nothing of the language on his arrival. This course appeared to the Editors to be the fairest towards Author and Readers.

Holland. An intimate acquaintance with the structure of language has indeed caused some persons engaged in this branch of education in Germany and Holland to entertain doubts as to the adaptability of the English and French languages for such purposes.

It is impossible here to enter into a discussion of the subject, or to attempt to refer fully to the different sounds and methods of teaching them to the deaf, and we therefore prefer to give publicity to effects attained rather than theoretical opinions. After an experience of five years with a class of deaf children, we cannot help agreeing that the utterance of the English language presents several difficulties not met with in Dutch and German; but in how far we have succeeded in combating with those difficulties will be to some extent seen from a perusal of the following cases:—

*First Case, F. R.**—This young lady affords an example of the class usually denominated "stone-deaf," and having probably been born so, it is fair to argue that her case does not differ materially from any of the most discouraging. She is about eleven years of age, and has been taught five years, of which the two first were spent in habituating her to a proper mode of observation, and in creating a love for inquiry; that is to say, in devising different means to excite her curiosity about things adapted to her age and circumstances, and particularly in effecting a series of exercises which should lay the foundation of utterance, and would promote the expansion of the chest. After that time study became more systematical. As we lay particular weight upon the physical attainments of the young deaf, as well as on the improvement of their minds, let us consider first the progress of this pupil *physically*.

Sounds of all classes used in the English language could be made at the end of the first year. The vowels, which it is rather difficult to extract from the totally deaf, were open and comparatively clear; we say comparatively, because it must not be supposed that the clearness of sound under such circumstances can at all equal the rounded tone of those blessed with an acute sense of hearing. The combinations of vowels and consonants could also be pronounced, and the physical power, therefore, of connecting spoken names with the idea of objects and actions was beginning to be developed. Speech, such as it was, was not however without defects.

The manipulation of the tutor, for correcting and facilitating speech is necessary for a considerable period of time; for when first a young mute begins to utter sounds of his own accord, he is frequently in the habit of interjecting letters or sounds which have no connection whatever with the words he wishes to pronounce; or his vowels and complex vowels, such as *i* (pronounced *ā ē*, as in *far* and *be*), are deteriorated by the practice of forcing the sound through the channel of the nose. The teacher, then, must be able to detect all these discrepancies, and would greatly neglect his work if he were to abstain from instantly rectifying these deviations from the true mode of articulation.

Returning to the pupil whose case we are considering, another advantage gained by her during the first year was the quickness of the

* The initials are, in all cases, slightly altered from the actual ones.

eye to distinguish variations in the position of the lips when moved slowly, and the ability to imitate these movements.

Exchange of thought is known to be of the greatest importance to the health and strength of mature minds, but what must it be to the growth of an immured infant mind? It is impossible to estimate the vast importance to be attached to the ability, in the deaf, of reading the lips, for to them the movements of the latter replace all the operations of sound, and it is their means of receiving the information needful for keeping up a healthy action of the brain. The early training of the vision, as well as of the vocal organs was, in this instance, not without its recompense. The pupil made use of her new faculties during the three succeeding years in a remarkable degree. The eye became gradually more efficacious to catch the observations of her parents, brothers, and friends, whilst the employment by her of organs of speech rewarded doubly the labour which had been bestowed upon her.

It is at present most gratifying to witness the pleasure which the child derives from her ability to read from her parents' lips whatever information they may have to communicate to her. Any words or set of words are conveyed by the eye to the mind almost as fast as they can be pronounced distinctly and separately; and for reasons already given, it is of no consequence whether or not sound is connected with the uttered word or sentence; the pupil catches the meaning of every position of the lips or facial muscles provided the organs of speech perform the same motions without as with the creation of sound. Speech is now inseparable from her social state and feelings; in fact, she has often been heard to talk in her dreams.

Let us now consider the *mental* progress of this pupil.

As we have already remarked, the mental faculties of the infant deaf must not be overburdened nor exercised too long. Half-an-hour's practice at a time will suffice. This pupil, accompanied by one to be called F. O., also a young girl, spent much time with us in the open air during the first two years, and we made a practice of showing them anything which attracted their attention, teaching them the names, and, as far as possible, the uses of objects. At the end of that time the pupil was consequently acquainted with a variety of trees, herbs, animals, road implements, grain, &c.; knew the difference between river, brook, and ditch; sand and clay, &c.; in fact, knew from her own observation a vast number of natural and artificial objects to be seen in our walks, and had derived much benefit from watching the farmer and mechanic. Being taught the words on the spot, the idea connected with the written or articulated name was clear, and the scene of action could be brought vividly before her.

She was able to understand such questions as—"What did the farmer cut?" "Where have you been?" "Who was out with you?" "Is the poplar dead?" Original questions put by herself would be shaped thus:—"What farmer cut?" "Who walk with you?" &c.; it being understood that the latter were given *viva voce*, and the former slowly read from the teacher's lips, and slowly repeated in plain tones by herself.

Similar questions, or simple propositions dictated to her, she could write down, and when they were written for her she could read them with intelligence. A slight acquaintance was also made with numbers; and at the end of the third year she possessed a good idea of the topography of Manchester and its suburbs, a larger understanding of things generally, and a knowledge of addition and subtraction, with numbers up to 100. Truly this was not very far advanced, but we preferred quality to quantity. A few other additions were made to the list of subjects in the fourth year; and now the girl is eleven it is probable that she knows as much as a child of average intelligence of the same age concerning grammar, the geography of the British Isles, the four elementary rules of arithmetic, and the early part of English history.

The following dialogue, taken down by the author *verbatim*, will show the mental calibre and speaking powers of this child. She had had an evening birthday party, and was conversing about it in the presence of her deaf companion, F. O.:—

F. R. "I was astonished to see Mrs. A. Mamma did not tell me." (Meaning, that the lady in question would be at her party.) "I asked her whether she would come to see me. She said, No." (Pause.) "I thought that she made fun with me."

Seeing me writing down the conversation, she said, "What for?"

F. O. (Her companion, also addressing herself to me) "What for? I ask you. Why do you write the same?"

F. R. (Answering her). "Fun! (A pause.) "Papa asked me where was his ring."

Teacher. "No; you must say, 'Papa asked me where his ring was.'"

F. R. "When uncle B. lied" (meaning 'lay on the floor') "Mr. A. rose him up."

Teacher. "No; lifted him up."

F. O. "Fanny's cousin pressed my foot when I danced."

F. R. "Rather rough." (Meaning that her cousin had been careless.)

Teacher (Correcting F. O.). "Trod on my foot."

F. R. "I told him, 'You must be quiet.' I cut the cake for girls."

Teacher. "That is a mistake—'I cut the cake for my friends.'"

F. R. "My papa sat near the cupboard. We could not go to the other side." (Meaning of the room.)

Teacher. "Why was your papa in the way?"

F. R. "Because the table is so long."

Teacher. "Did you ask your papa to make room?"

F. S. "Afterwards" (meaning after tea was over) "Fanny and I went up stairs to see Matilda" (her baby sister), "and she was afraid of Fanny."

Second Case, F. O.

To form an adequate idea of the exact condition of the lost sense of this young lady, it must be born in mind that not all persons who are designated stone-deaf are absolutely so in the strictest sense. A large

number of them, especially many of those whose affliction is accidental (the result of illness in infancy), have a remnant of hearing left, and though that may be exceedingly slight, it cannot escape the notice of the teacher after a few weeks' practice with the organs of speech. It did not in this case, for scarce a fortnight had passed over, when the ring of her voice, while emitting sound, made the fact clear that though for all practical purposes as deaf as F. R., still as regards the pliancy of her vocal organs she was more fortunately situated than her school-companion. We knew from experience in Rotterdam, that in time she would be able to imitate words with greater precision, and that the tuition of her speech would cause us less labour and less careful deliberation. These expectations were not raised in vain.

It took little more than four months to make her pronounce the vowels, complex vowels as *i*, *oi*, *ou*, *you*, &c., and consonants, with clearness.

And notwithstanding that her tendency to close the nasal channel necessitated caution in the practice of *m*, *n*, *ng*, and *nk*, and enforced upon us the obligation to continue the exercises with these letters for a longer period than usual, after a lapse of nine months, she not only knew to combine them satisfactorily with all others, but could do so without the teacher's interference.

The exercises for labial instruction were the same as of F. R. The results showed again that from any part of the room, single letters, syllables, and words could be distinguished or understood, and that when in the open air, close by or at a distance, it was possible to interchange thoughts with her by uttering the words in a strongly-marked manner. It may be said then that the greater part of the first year was principally taken up in *preparing* this pupil, and that as soon as she was enabled to express her simple ideas by speech or writing, and could understand the thoughts of others by reading spoken or written words, the sole object of the following years would be the development of the mind. But as mechanical speech can be taught with exercises which have meaning as well as without them, it is natural that we chose those which were calculated to store the mind with names of useful objects; and it is evident, therefore, that the mental faculties even during the preparatory course were not altogether dormant. In this manner the youthful memory had been accustomed beforehand to retain a variety of names, long and short; a circumstance which was of great service when we undertook in the second year to instruct her in the art of reading and writing easy sentences. It would be tedious to enumerate here the various sets of exercises that were given to initiate the pupil in easy language, but it may be worthy of notice that the descriptions of pictures or events usually given to the deaf were read by the pupils in an audible voice, and that we repeatedly invited them to relate to us slowly and as distinctly as possible, whatever incidents they had witnessed on their way to school.

Thus they were encouraged to talk, the exercise of their powers of observation and reflection was most direct, and the opportunities for correcting their grammar and mode of articulation were manifold and fruitful.

All through the course of instruction, *reading* has since formed the principal feature in the daily studies of this pupil.

Much knowledge was stored up during the third and fourth year, by entering into the meaning of easy stories, descriptions of animals, short and simply written essays on articles of food, manufactures, &c. Later on, subject-matter was found in the study of topography, for which we drew up a series of lessons, framed in a manner that would draw the pupil's attention to space as defined by the house, by the immediate neighbourhood, by the village, and finally by the town and district. This brought her (and her companions) in a natural way to the consideration of public buildings and their history; which latter, however, was entered upon only in so far as it would serve our design to illustrate the meaning of the term, "history," as applied to Manchester, and the history of England. What other observations were made in thus examining the chief parts of a large manufacturing town one may readily guess. Ocular illustration aiding greatly to heighten the interest in, and the proper understanding of these lessons, the arrival of the hour known to be set apart for their initiation in the geography of the district (Lancashire) was met with a smiling countenance.

The geography of the British Isles has always been a favourite subject of this pupil, and since it is concluded she has shown no less pleasure in reading and committing to memory several of the noteworthy points presented by an outline-description of our interesting part of the globe.

With equal zeal has she been engaged during the last year in the study of the history of England, up to the time of the annexation of the principality of Wales. When she is now endeavouring to improve herself in any branch of instruction, it cannot be said that that branch exclusively engrosses her attention; for so much similarity of grammatical form and construction presents itself in written language, and so many kindred observations on various topics are contained in any book of simple composition, that its perusal is to her quite as valuable for the repetition of previously-obtained information, as for the acquisition of any fresh knowledge. Of what the friend of the deaf has to make a particular study, is the form of language in which knowledge may be clothed. The least misconception of a word throws them off their guard, and drawing conclusions from the context is a thing altogether unknown to nearly every one thus afflicted.

Constant practice in conversation, the reading of books whose style is not above their comprehension, habituating them to the use of the dictionary, and unceasing care in correcting their mistakes, are the only means, therefore, that can operate successfully to initiate them into the mysteries of a rich, refined, and complicated language.

We might dilate now on the great advantages this young lady derived from the assistance she received at home, but as this point will not be overlooked in the account of the next example, the observations there being also more or less applicable to this and the previous case, we shall conclude this description with a few notes on the subject of arithmetic.

XUM

Calculations with numbers form to the reasoning powers of the young deaf such a source of embarrassment, that this branch of their instruction demands from the tutor a more than average amount of patience and perseverance, and enjoins on him the obligation to give preparatory exercises with practical illustrations. Indeed this method has to be resorted to whenever the pupil is brought to a stop, which is by no means a rare occurrence. This pupil discovered her difficulties when she attempted to work examples like the following:—

Write in numbers six thousand and thirty.

Add together 198; 74; and 87.

Find the difference between 214 and 96.

Multiply 908 by 70, &c.

Problems similar to the two last could only be done after three years' schooling; and division presents difficulties of a nature that doubtless perplex many of the deaf of any age. Facility being obtained in the mechanical working out of such questions on a more extended scale, the useful practice of mental arithmetic was commenced. A few examples of the character of those which are given to her (and her class), twice a-week, we subjoin:—

1. Suppose a lady bought 7 yards of calico at 8*d.* a yard, and paid 60 pence. What had the shopkeeper to return to her?

2. Six children got 41*l.* from their parents and 7*l.* from their uncle. The whole was divided between them. What had each child to receive?

3. If John bought 9 marbles and Willie 5, how many marbles more had Peter if he had 17?

The following is a *verbatim* conversation held with this pupil while out on a walk.

Teacher. (With tablet in hand, searching for his pencil.)

Pupil. "Have you lost your pencil?"

Teacher. "No; I think not."

"Master M." (met on the road just before) "told me that his mamma has been to Scotland and Ireland, and will return this evening. Would you like to go there?"

Pupil. "I have been to Ireland—I should like to go to Scotland."

Teacher. "Why?"

Pupil. "Because I have never been there."

Teacher. "Where should you like to go, if you went there?"

Pupil. "The same as mamma went."

Teacher. "Yes—but where?"

Pupil. "To Glasgow, Edinburgh, Perth, and Lanark."

Teacher. "Has your papa not promised to take you to Scotland?"

Pupil. "Oh, yes."

Teacher. "When will he take you?"

Pupil. "Papa said, when I am 14 or 15 years old." (Laughing because the teacher wrote these sentences.) "Why do you write the same as I talk?" (Looking at the tablet.)

Teacher. "Because I want to remember what you say, and what

mistakes you make. Where will your mamma take you in the holidays, do you think?"

Pupil. "I do not know." (Interval.) "A. sent H." (two of her brothers) "a nice book, *namely* Longfellow's poems, because it was his birthday." (The confounding of *namely* with *named* or *called* will be observed.)

Teacher. "Did you see it?"

Pupil. "No. I think H. will show me next month."

Teacher. Show you what?"

Pupil. "Show me *it.*

Teacher. "Do you suppose you can read it?"

Pupil. "I think so."

Teacher. "But do you think you can understand it?"

Pupil. No.—"

Third Case.

J. M. A. is a boy, 11 years of age, and has been under instruction two years and eight months. His previous condition may be conceived from the appended certificate written by the rector of the village whence he came, and from the fact of his being able to utter half-a-dozen words, as "papa, mamma, bat," &c., in an indistinct manner and from remembrance of former times.

"Feb. 28, 1862.

"I hereby certify that J. M. A. has been well known to me for the last four years; that I have had many opportunities of observing him. He appears to have some degree of hearing, and a slight, though at present, very slight power of speech. I further consider him to possess considerable intelligence, but, from his defective hearing and speech, not capable of being instructed in the usual mode adopted with other boys."

Under these circumstances I need hardly remark that nature's tendency wanted but little of human art to re-establish the mechanical use of a faculty lost through a woful disease in infant age. Gaining the intelligent use of that faculty was a matter of time, because the organs of hearing were only sufficiently sensitive to be useful when acting in concert with those of touch; and oral sounds were not imitated by the single agency of the ear. The relatives of the boy and a private teacher had tried that experiment by shouting in the ear, but beyond the echo of the few simple words that were learnt as an infant, nothing could be taught. In cultivating the voice then, it was essential to keep two objects in view. One, to accustom the boy to depend upon muscular action, and to pay attention to the positions of the vocal organs; the other, to exercise his hearing, which latter is of great moment, when it be remembered that experience shows that hearing *when it presents itself to such a degree as was the case here*, seems to improve, if its sense be cultivated simultaneously with the practice to let the deaf child feel the vibration which sound causes on the top of the throat and elsewhere. One example will make this plain. Suppose the sound of the word "like" was made in a full

tone at the boy's ear (that one with which he hears the best) before instruction, he would perceive a noise but could not repeat it, but at present, when the word was called out aloud and close to his ear, he *would* be able to do so, for two reasons: firstly, because by practice his hearing may have become intrinsically slightly better; and secondly (and this we consider the main if not the sole reason), because he has learned to imitate the sound with the aid of the sense of touch, and was therefore sufficiently acquainted with its nature and its meaning to distinguish it from all others, when it reached the mind through the medium of the ear.

Nevertheless, the reader must not hastily conclude that the pupil would thenceforth be enabled to understand any word that is spoken loudly to him. Far from it. He can only do so when it is short, the meaning well understood, and the word pronounced by itself. When he has become more intimately acquainted with the various meanings of the majority of ordinary words, it may be expected that his hearing will be of greater practical utility, and it is sure that it will be a still more valuable support to his indispensable acquirements of "lip reading."

The results, then, of oral tuition with this and other children, induce us to express the earnest wish that the Directors of Institutions for the "Deaf and Dumb" (whatever their views on the method of articulation may be) will consider seriously when mutes thus circumstanced are introduced to them, whether or not it be advisable to have them educated according to the principle of dactyology,* inasmuch as these results clearly prove that instead of being capable of learning a few sentences, as some have presumed, they can be made acquainted with a whole language whilst they may be much benefited by a careful treatment of their impaired sense of hearing.

The mental growth of this pupil has been an object of great interest to his relatives and to his teacher, for the rapidity with which he has gained and is gaining grammatical knowledge and practical information is surprising—a fact which can only be explained by the laudable care his parents bestow upon him, and by the due attention they have paid to any friendly advice we have had to offer them. Explanations of words or sentences which slipped the memory after the time of instruction, were renewed, whilst others originated from conversation and literary occupation at home, so that the reasoning faculties were not merely usefully engaged during school-hours but profited him much after them.

The poverty in language which Dr. Kitto has called "the distressing dearth of matter in the letters and other writings of the deaf" and its cause, we pointed out to his parents, and it had the desired effect of making them still more determined to correct his errors, to keep up the greater part of what he learned at school, and to redouble their efforts to make him conversant with colloquial phrases and the comprehensive parts of any newspaper or children's book that seemed to interest or amuse him. The result is, that though his memory lacks much of its retentive power, he has acquired during the short time of

* Speaking or communicating with the fingers.

his instruction, a greater amount of language and general information than anyone would anticipate, who is well acquainted with the disadvantages of the deaf.

It would be difficult to estimate roughly the progress he has made in the ordinary branches of instruction, for although limits might be indicated in reading, writing, geography, and history, they could only be indistinct and unsatisfactory, arising from the circumstance that many new and valuable ideas are picked up by him from sources wholly apart from his regular course of study.

One of the most beneficial of these consists in the reading of the daily and weekly newspapers, as will be seen by the conversation which follows; which increases his stock of words and expressions by many valuable additions. The many events of the history of the day are the more attractive to him, because he easily discovers that the interest taken in them is not confined to himself. Conscious of that fact, he freely inquires about all that passes near and far, and will imperceptibly be led to the knowledge of that chain of current events by which life becomes much more enjoyable for one who is deprived of such a valuable treasure as the sense of hearing.

Of the powers of conversation and general attainments of this boy, the following dialogue between him and one of the Editors of this Journal will be an illustration. We three had been visiting the Brown Museum and a large ironmonger's shop together the day before, and the author of this paper took down the conversation, word for word. Nearly all that the boy had seen was quite new to him :—

Editor. "Tell me what you saw in the museum yesterday."

J. M. A. "I saw a rolling machine." (Pausing and reflecting.) "Not in the museum." (It was a garden roller he had seen in the ironmonger's shop.)

Ed. "I asked you, in the museum?"

J. M. A. "I saw a large skeleton of a large whale. I saw a beautiful crab; a common crab. I saw the tortoise; the American frogs; a balilla—large—a large monkey." (Meaning gorilla.)

Ed. "You must tell me the proper name of that monkey."

J. M. A. "Ape." (He had been told the day before that the gorilla was an ape.)

Ed. "That is not the proper name of the animal. Tell me the name of that large ape; not *Bal*illa."

J. M. A. "I cannot tell."

Ed. "You must try."

J. M. A. (Shaking his head after some reflection). "I cannot tell you the name of the ape."

Ed. "Do you read the newspapers?"

J. M. A. "Not always. Yes; at home."

Ed. "Do you know that a Frenchman brought many of those apes from Africa?"

J. M. A. "Yes."

Ed. "What is his name?"

J. M. A. "His name is Captain Grant." (Thinking and shaking

his head.) "Dr. Livingstone." (Reflecting again.) "No; I cannot tell you the name of the African traveller."

Ed. "I will spell it for you. D-u." (The boy repeated the letters.) "What does that spell?"

J. M. A. "Du."

Ed. "C-h-a-i-l-l-u."

J. M. A. "Challoo." (So he pronounced it.)

Ed. "Put the two together."

J. M. A. "Du Chaillu. I have never heard of that name."

Ed. (After waiting a little). "What name?" (The boy repeated it.) "He first brought the gorilla into England. Now go on; tell me what you saw."

J. M. A. "I saw a fish. Its name is jack. Do you know?"

Ed "Very likely; but I did not see it. Go on."

J. M. A. "I saw three prawns; they are very pretty." (They had been looking at the aquarium.)

Ed. "Were they dead?" (He did not read the word "dead" quickly from the lips.) "Were they alive?"

J. M. A. (Nodding). "Alive."

Ed. "What were they moving in?"

J. M. A. "They were moving their legs."

Ed. "You do not understand me. *In* what did the prawns move?" (No answer.) "Was it in a teapot?"

J. M. A. (Laughing). "No; in a glass box full of water."

Ed. "Tell me what more you saw."

J. M. A. "I have seen——"

Ed. "Wrong!"

J. M. A. "I *saw* an artificial town, in down-stairs" (correcting himself)—"in the lower room."

Ed. "What do you call a small town made of wood, and put under a glass case?" (It was the model of Liverpool.)

J. M. A. "There is no name." (Meaning on the town; he did not see the name.)

Ed. "What do you call a small engine?" (Showing the size of a model with his hands.)

J. M. A. Shook his head.

Ed. "A model." (He had never heard the word before, and it was therefore written down for him.) "Tell me what else you saw?"

J M. A. "I saw a small ship, which bears three masts."

Ed. "Also a model."

J. M. A. "Yes; a model."

These are a few examples of the tuition of the deaf by "lip-reading" and articulation instead of by dactyology, and we hope the day is not far distant when the former will supplant the latter wherever it is practicable.

PETROLEUM:

Its Importance, its History; Boring, Refining.

By HENRY DRAPER, M.D., Professor of Natural Science in the University of New York.

IN a country so large in area and yet so sparsely settled as the United States, the tendency of men is to become extremely practical, and to neglect things which do not seem to have an obvious bearing on the production of wealth. Heretofore the attention of a great part of the community has been directed to a peculiar agriculture, in order to extract the treasures of the soil as quickly as possible. As has been well said, we commonly affirm that we are devoted to agriculture. We count up the preponderating millions who spend their lives in that pursuit. We say that we are a producing nation. It is not so. Agriculture has never been practised in the United States. We are miners not farmers. We clear land and put a new field in tobacco. In due season we send the produce to market. We put the same crop in the same land a second year; but if we try it a third or fourth we fail, for the tobacco will not grow.

How is this? The plant has exhausted the soil of one of its ingredients necessary to fertility—its potash. Now in the absence of that substance, which is essential to its very constitution, it can no longer come to maturity. What, then, is the difference between the Virginian who has been setting tobacco plants to collect the potash from his land, and the Californian who has been employing men to wash his soil for gold? Both have sold or sent to other countries the inorganic material that was their source of wealth. Both have impoverished their estates. Both are miners.

Consider what has been going on for the last two centuries along the whole Atlantic coast, for what has been said is only a forcible presentment of what is going on everywhere. It holds good for the cotton, the wheat, the corn. From the shore line there has been an onward march up the gentle incline of the continent. Strand after strand of fertile soil has yielded up its wealth. The front of the vast phalanx has already touched those regions where the rains are uncertain, and therefore the seasons unreliable. Beyond them is the untrodden desert.

A knowledge of what is thus approacing has caused much attention to be devoted to the development of the other mineral resources of the country. Gold, silver, mercury, iron, copper, coal, and a multitude of other valuable substances. are being continually detected in places in which their existence was previously unknown. Among these discoveries, that of Petroleum is without doubt the most remarkable. Although I have already made mention of a few facts in its history in a former article, the importance of the subject is sufficient apology for referring to it more in detail, and for presenting the following account derived from various American sources.

Four years ago, Petroleum may be said to have been generally unknown in America; now it is one of the most important articles, both of home consumption and foreign exportation. Its value is not less than one-fourth of that of the cotton-crop, the best estimates setting it down at 15,000,000*l.* sterling per annum. A statement of the facts known about it should be of especial interest, not only in England but also on the Continent, because if bored for in those localities in which it is now known to exist, or in which signs may be detected, the same result may be attained as in Pennsylvania. It is no exaggeration to say that its presence is more desirable than that of gold. What Californian or Australian can rival John Steele, of Oil Creek Valley, who is said to derive 150,000*l.* a year from mines on his property?

The existence of Petroleum, and its use as an illuminator, have been known for centuries, not only in the East, but also in Europe. The Greeks and Romans were acquainted with it, a spring in Zante being referred to by Herodotus, and according to Dioscorides, the oil was collected and burned in lamps by the inhabitants of Agrigentum, in Sicily. Some of the places at which it has been found are Bakoo in Georgia, on the borders of the Caspian, "at the foot of the Caucasus fountains of naphtha put fire into the hand of man," Rangoon in Burmah, Amiano in the Duchy of Parma, Saint Zibio in the Grand Duchy of Modena, Neufchatel in Switzerland, Clermont in France, some points on the banks of the Iser, Gabian, a village near Bezières, Tegernsee in Bavaria, Val di Noto in Sicily, in Zante, Gallicia, Wallachia, Barbadoes, England, the United States.

At Amiano in Italy, Petroleum has been extracted for two hundred years by merely digging pits in the ground and collecting the fluid that oozed from the soil in vessels at the bottom of the pits. No attempt has been made at purification, the various kinds being merely mixed together to secure a uniform product. The supplies procured from this source have furnished the means of lighting the cities of Parma and Genoa. At Bakoo large quantities of inflammable gases and liquids rise to the surface of the ground. They are found over a narrow tract of twelve square miles in extent, the strata being of porous argillaceous sandstone, belonging to the tertiary period, and full of fossil shells. The oil is collected in the same way as in Italy. That obtained from the central parts of the district is of a faint yellow tint, while toward the sides of the tract, it gradually passes through shades of green and brown into asphaltum. The quantities annually collected are, according to M. Abich, valued at 120,000*l.* Over large districts in Persia, no other illuminating material is used. The phenomena it presents cause the region to be called the Field of Fire, and made Bakoo the sacred city of the Guebras or Fire-worshippers. The Rangoon district on the Irawaddy has also produced enormous quantities of Petroleum. For an unknown length of time the Empire of Burmah and a large part of India has been supplied from it with oil. According to Syme (Embassy to Ava), the number of wells exceeds 520, and the annual yield is 400,000 hogsheads. Another authority states that each well yields annually 173 casks, of 950 pounds. The oil is used for burning, preserving timber against insects, and for

medicinal purposes. An attempt has been made in England to use it as a means of forming paraffine candles.

In America, Petroleum was known to the Seneca Indians, who have a tradition to the effect that its existence was revealed to one of their chiefs in a dream by the Great Spirit. He was directed to proceed to a certain spot, where he would find a liquid, oozing from the earth, a healing balm to his tribe. Even at this day "Seneca oil" can be procured in the drug shops, and is supposed to possess virtues in skin diseases and rheumatism. Day, in his "History of Pennsylvania," states, that the Indians esteemed this oil very highly, using it to mix with their war paint, and also for religious purposes. He quotes a letter from the Commander of Fort Duquesne to General Montcalm, in which an assembly of Indians, by night on the banks of the creek, is described. In the midst of their ceremonies, the oil that had collected on the surface of the water was fired, and simultaneously a shout of triumph burst forth, that made the hills re-echo again. The scene reminded the writer of what is related of the rites of the ancient Fire-worshippers.

When the whites occupied the land in Pennsylvania, from which the Indians had been in the habit of procuring this oil, they found excavations which had been used for collecting it as it came to the surface, and some of these still exist on the Rynd farm, near Oil Creek. The oil may be gathered by spreading woollen cloths on the surface of the water, and wringing them when saturated. It was not, however, till long after, that the Petroleum oil became generally known as an illuminator, and only since 1859 have wells been sunk with the specific object of obtaining it. The first of these was dug under the auspices of a New Haven Company, by Colonel Drake, who succeeded in striking oil near Titusville, Crawford County, Pennsylvania, and making fortunes both for himself and his friends. These fortunes have been far eclipsed by those since accumulated in the same region, a great many persons having become millionnaires.

Previously to Drake's operations, however, in 1819, in boring for salt on the Little Muskingum river, in Ohio, one of the two wells sunk discharged vast quantities of Petroleum and gas, in an explosive way, and although Dr. Hildreth states that it was in some demand for lamps in workshops and manufactories, and predicted that it would be "a valuable article for lighting the streets of the future cities of Ohio," yet for more than thirty years it did not come to be used in this way, and might have remained still longer comparatively unknown, had it not been for the attempted production of illuminating oils from the slow distillation of bituminous shales and coal. It was the application of the methods of purification thus learned, that enabled Petroleum, or rather Kerosene, one of its distilled products, to replace the animal and vegetable oils previously used.

The method of working to get oil is as follows:—The land is either bought or leased; in the latter case one-half of the soil goes as a royalty to the owner. An engine and machinery have then to be brought to the site. The latter contains, as an essential feature, a walking beam, of about thirty inches stroke, to communicate motion

to the drill. An iron pipe, six inches in interior diameter, and one inch thick, is driven down by a pile driver till it reaches the solid rock, a distance of perhaps sixty feet. This tube is then freed from its contents by a sort of pump, a hollow piston, six feet long, with a valve at the bottom, opening upwards. As soon as this part of the operation is completed, the drilling of the solid rock is commenced. The drilling tool is a solid rod, weighing 800 lbs., and is thirty feet long. It is attached to a rope an inch and a half in diameter. The bit which forms the end of the drilling tool is three inches and a half wide. After it has perforated the rock five or six feet, it is replaced by a "rammer," a cylindrical tool four and a half inches wide across the face, intended to make the hole round and smooth. At intervals, the pump above mentioned is inserted to clear away the *débris*. The strata passed through in Oil Creek Valley are, according to the phraseology of the miners: first, slate rock, 100 feet thick; then sand rock, perhaps 30 feet thick; then soap rock, 125 feet thick; and after that a second sand rock. This may vary from 10 to 25 feet. After going through another slate and soap rock, the third sand rock is reached at a depth of 430 feet. In this the oil is found in the largest quantities. Occasionally the oil is found in the second sand rock. After the well is bored a short distance into the third sand rock, it is lined with two-inch gaspipe, and if the contents are not expelled spontaneously, it is pumped to ascertain whether oil has been reached.

It not infrequently happens that a boring proves unsuccessful after all this labour, for it by no means follows that, even if in the neighbourhood of a well that is already yielding, it will strike a reservoir. There is no resource under such circumstances but to abandon it and sink another. On the other hand the oil, if found, may rush up with the greatest violence in wonderful quantity, and may even carry away the derrick and other parts of the boring machinery. Such wells may eject a thousand or more barrels a day, and then suddenly cease to flow. It is necessary to resort to pumping in that case, and to be contented with a more moderate product of from five to twenty barrels a day. Water saturated with salt is not infrequently struck, but this, though highly valued in other places, as at Syracuse, in New York, is here regarded as of no avail, and allowed to run to waste. The value of the fortunes suddenly acquired, is in many cases entirely unknown to the owners. A correspondent of the 'Herald' states, that he "was paddled across the creek by an oil prince, aged fifteen, heir to a million, coatless and hatless, and with but one suspender."

The oil regions are being rapidly penetrated by railways, the capital being to a large extent furnished by foreigners. It is expected that there will be continuous communication throughout the most populous part before spring. The value of the soil in the neighbourhood of Oil Creek, that is, of a strip on each side two miles wide and twenty miles long is estimated at 50,000,000*l.* sterling. Four years ago it was worth about 1*l.* an acre. Some farms valued at 400*l.* before the excitement, have since been purchased at prices varying from 120,000*l.* to 200,000*l.* and are now rated at a much higher amount.

The expense of boring a well, including a ten-horse power engine,

engineers' and other men's wages, tools, tubing, coal, &c., is about 1,200*l.* In addition, a certain allowance must be made for accidents, such as breaking of the boring tools, and difficulties of extracting it. The profits made on the oil are very large, the cost of a barrel of forty-one gallons, including freight to New York, being about 3*l.*, while it may sell for nearly 4*l.* The crude oil is worth, at the wells, about 1*l.* 10*s.* a barrel. Of course these prices fluctuate considerably. It is now proposed to conduct the Petroleum in gas pipes to the termini of the railroads, so as to lessen the expense of cartage, which is about 6*s.* a barrel at present rates. These pipes will have to run distances of from seven to twelve miles.

The amount of oil sent abroad is continually increasing. Antwerp alone having taken, in the first eight months of 1864, 135,000 barrels of refined and crude. In New York city, a regular Petroleum Board has been established, which is attended by four or five hundred dealers in the article. Up to the present, there have been formed two hundred and fifty companies for the working of these borings, representing a capital of 30,000,000*l.*

The use of Petroleum, or rather certain of its ingredients, as a fuel, has been proposed in the case of steamers making long voyages. The advantages are, of course, sufficiently obvious, decreased bulk as compared with coal, absence of ash, mobility. On the other hand, there are the difficulties of contriving a suitable furnace, and the danger from fire. At the oil wells themselves, for instance, in the Downer Refinery, they are, however, using the refuse of distillation for heating the necessary apparatus, and some of the pumping engines generate steam by the aid of the combustible gas that is so commonly associated with the Petroleum, it only being necessary to conduct it by a pipe from the tanks in which the oil accumulates to the furnace of the engine.

Besides the discoveries of Petroleum in Western Pennsylvania, to which the preceding statements principally refer, it has also been found in Western Virginia, North-western New York, Ohio, Central Kentucky, Michigan, and Canada. In Michigan, boring is now being conducted at "Burning Spring," a place on Lake Michigan, so named by the Indians, and with every prospect of success. In Western Virginia, the wells do not require to be bored so deeply as in Pennsylvania. In Ohio and Virginia, the Petroleum is found in the coal measures, and the wells have often to be sunk through these into the sandstones and slates below, before becoming productive. In North-west Pennsylvania, and in New York, the wells are entirely outside of the coal field, and so remote, that one can hardly imagine any connection between the two. The strata in which the oil is found dip south, and pass below the coal-measures at least 500 or 600 feet, the nearest coal-bed to the more northern springs occurring on the tops of the highest hills, thirty miles distant. The oil wells in this group are bored through alternating layers of shales and sandstones, and an occasional layer of bluish sandy limestone. The next group, below, is that known as the Hamilton Shales in New York, and in Ohio as the black slate. Dr. Newberry considers this the source that affords the

XUM

Petroleum. It contains much carbonaceous matter, and is supposed by him to be sufficient for generating the supplies forced to the surface by the conjoined pressure of water and carburetted hydrogen, furnished from the same material. It is from these states that the oil springs of Canada West issue, and these are far distant from the coal formation.

The origin of these hydrocarbon compounds is, however, still a vexed question. That they are the product of the fermentation of either vegetable or animal substances, is admitted on all hands. In the United States there is no evidence to contradict the supposition that they result from the bituminous fermentation of vegetable matter; but in Canada, where they are found in the lower Silurian limestone, they have been suspected to be of animal origin. "The cavities of large orthoceratites have been found filled with Petroleum, but so fetid as to be most offensive." As to the duration of the supply, there is, of course, no certainty. The Rainanghong wells in Burmah have flowed for ages; and some of these American wells have resisted the steam pump successfully for four years. If Petroleum is regarded as having passed through the intermediate stage of an association with bituminous shale or coal, and having undergone a process of distillation, the observations of Professor H. D. Rogers as to the greater and greater decrease of volatile matters in the Appalachian coal field, as you come from the west toward the east, would be of great importance. He states that at the western limit, where the strata are still horizontal, the proportion of volatile matter may reach forty or fifty per cent., while on the eastern side, in the boldest flexures of the Appalachian chain, where the strata have been actually turned over, we find the coal to contain only from six to twelve per cent. of bitumen, thus becoming a genuine anthracite. Sir Charles Lyell, in examining these observations says, that "there is an intimate connection between the extent to which the coal has parted with its gaseous contents, and the amount of disturbance which the strata have undergone. The coincidence of these phenomena may be attributed partly to the greater facility afforded for the escape of volatile matter, where the fracturing of the rocks had produced an infinite number of cracks and crevices, and also to the heat of the gases and water penetrating these cracks when the great movements took place which have rent and folded the Appalachian strata.

Professor E. W. Evans, of Marietta College, has recently published the result of his investigations on oil wells in the 'American Journal of Science.' He thinks that the principal supplies of Petroleum are not diffused between the planes of stratification, but are collected in cavities more or less sunken in the strata, where it is less liable to be carried away by running water. The places in which it is sought for with most prospect of success are those where there are marks of disturbance and displacement of the rocks. The cavities have been caused by erosion or uplifts, and are usually of slight, horizontal extent, so that two neighbouring wells but rarely strike oil at the same depth. Besides, the drill, as it enters the oil cavity, sinks, variously, from four or five inches to as many feet, sometimes sticking

fast as if between the oblique sides of a narrow fissure. He shows that from certain facts connected with their intermittence and occasional interference with one another, the wells are often connected by channels more or less free, running, sometimes along the strata, sometimes across them. The productiveness of a well depends upon its entering either one of the main reservoirs, or some of its important connections. Every collection of oil is accompanied by varying quantities of gas and water, the gas being above and the water below. The material yielded by a well turns on the part of the cavity entered. If it is pierced near the top, gas first escapes with violence, and subsequently, as water enters such cavities readily, the oil is floated to the end of the boring, and may be pumped out. If, however, water enters more quickly than the oil is removed, the latter may be floated to the higher parts of the cavity, and be out of reach till the former is pumped away. If the middle parts of the cavity are tapped, oil rises at once in the well, forced up by the gas at the upper part, and may be thrown out from the mouth of the well. This will continue till the pressure of the gas is equal to the hydrostatic pressure of the column of oil, when pumping out must be resorted to. If the lower parts of the cavity are tapped, water at first will be the only product; but if this be pumped out, oil will at length be reached. It will rise in the tube one-fourth higher than the water, on account of its less specific gravity, ·816, and thus a very unpromising well may prove productive. The Shattuck well on the Little Kanawha had to be drained of water with a steam pump for two weeks before oil was obtained, but after that it yielded abundantly.

In addition to this class of wells, which seem to consist of but one isolated cavity, and which may be permanently exhausted, there is another class in which the oil is more or less quickly replenished. These are distinguished as intermittent wells, and where one is found, it is a sign that there are many oil cavities near together in the same locality. If it yields copiously for many months in succession, without diminution in quantity, or increase in the intervals of yield, the rocks in its neighbourhood may be presumed to contain rich supplies of oil that may be directly reached.

On Oil Creek, in Pennsylvania, most of the oil is found in the same stratum of sandstone, the rock seeming to be perfectly honeycombed with Petroleum cavities. The action of many of the wells is as follows:—When oil is entered, the gas begins to raise it over the top of the boring, increasing gradually in force till it projects perhaps forty or fifty feet into the air, then alternately it increases and diminishes in force at regular intervals. These variations in the force of the gas, or "breathings of the earth," as they are called, are explained by supposing that, as the tension of the gas is relaxed by the removal of oil, the gas and oil from other cavities rush in through the slight fissures, until the maximum tension is again reached. A well may alternate two or three times in a day, or as often in an hour; it may almost cease to yield, and then suddenly give out more than ever before, owing to the bursting in of a new supply from some untouched source, solicited by the decreased pressure.

Professor Evans does not think that in any case the oil is raised to the surface by the direct pressure of water, the heads of which are higher than the issue, as Artesian wells are said to be produced, but inclines to the belief that the flow is due exclusively to the pressure of gas accumulations. In support of this, he shows that gas always escapes from spouting wells, and that a current of water would be sure to float away the oil, the springs in such vicinities being tainted in this way. The finding of oil in association with water is not, however, a reliable sign of the presence of oil below, because it may have come many miles; but the presence of gas, which is much less likely to be transported downwards and to a distance, is regarded as a valuable indication.

Petroleum of different localities varies greatly in character. Ordinarily of a greenish colour, it may present greater or less degrees of opacity; it is sometimes reddish; as it occurs in nature it is of no fixed composition, but consists of various hydrocarbons holding in solution paraffine, and more or less bitumen or asphaltum. The appearance of the oil turns on the proportion of these solid ingredients. As the amount of asphaltum increases, the oil becomes more and more like tar, eventually passing into a substance possessing so little fluid matter as to be solid at ordinary temperatures. This is its condition as found in Tar Lake, in the island of Trinidad, and it is then suitable for making pavements or hydraulic works, or for replacing pitch. The refined oil has a characteristic smell, which is not entirely removed by the usual process of purification, though, by standing several days over an alkaline solution and freely exposed to the air, it may be caused to disappear. The best American oils are those from Oil Creek, which mark 46° on Braumè's hydrometer; those from Mecca have a density of 26° or 27°, and will not flow when cold. A new method has been recently introduced for testing the illuminating oil, instead of depending on the hydrometer alone; it consists in observing the temperature to which the fluid must be raised before it can be set on fire by a flame. That is preferred which ignites at from 100° to 120° Fahr. The proportion of light oils suitable for burning in the best Petroleum is sometimes ninety per cent.; other specimens will not yield thirty per cent. The heavy oils parted from these during distillation are only useful for lubricating, and even then require the admixture of animal oil to give body. The paraffine which remains behind with the heavy oils is separated by the aid of cooling mixtures and pressure, and exists in very different proportions in different samples. The average yield is said to be about one pound from four gallons of Petroleum.

The processes for rectification of Petroleum do not differ greatly from those formerly used for crude coal oil, produced from the distillation of bituminous shales, &c. This latter operation is an old one, having been patented in England in 1694 by Martin Eele, Thomas Hancock, and William Portlock. The discovery does not seem to have been attended by any practical consequences until the present century, when the whole subject of the effect of distillation at high and low temperatures, not only of these but of animal and vegetable substances, was thoroughly

investigated by Reichenbach, and many new products among the paraffine discovered. Christison, in England, also discovered paraffine about the same time. Afterwards the matter attracted great attention in France, and in the patents taken out by Selligue and others in that country, from 1834 to 1845, full details of apparatus, which has not been essentially improved up to the present day, are to be found. In the patent of March 19th, 1845, Selligue enumerates the products of distillation as,—1, a limpid whitish volatile oil, useful as a solvent, and sometimes called naphtha; 2, a straw-coloured oil suitable for burning in lamps with a double current of air; 3, a heavier oil for lubricating; 4, a red colouring matter; 5, paraffine; 6, a grease composed of paraffine and oil; 7, a black pitch; 8, an alkaline soap; 9, sulphate of ammonia; 10, ammoniacal fertilizing liquors; 11, sulphate of alumina. His plan was to treat the crude coal oil obtained from the retorts in which the bituminous substance was distilled with a strong mineral acid, and agitate it thoroughly. This caused the tarry matters to subside with the acid. The slight proportion of acid remaining with the oil was neutralized by an alkali, which caused another precipitate of tar and colouring matter. The oils were then separated from one another by fractional distillation.

In England, and also in America, the introduction of coal-oil distillation is due to James Young of Glasgow, whose attention was attracted to the subject by the exudation of Petroleum from a coal mine in Derbyshire. He subsequently found that the Boghead Canal was the most suitable mineral for the manufacture of coal oil, and in 1854 extracted at the rate of eight thousand gallons a-week, or 100,000*l.* worth per annum. From England the manufacture extended to the United States, Young having patented his process in both countries, the intention being to use the Boghead Canal of Nova Scotia, or some similar material from the West. The best specimens of the Boghead Canal were found capable of yielding a hundred and thirty gallons of crude oil, or seventy-five gallons of refined oil per ton. Many varieties of coal found in Kentucky and Ohio would produce nearly as great an amount. In 1860 the total number of manufactories in the United States was more than sixty. Of course the discovery of the Petroleum deposits has entirely destroyed this branch of industry. Nature can distil more cheaply than man.

The success of coal distillation turns on using a temperature not high enough to produce gaseous matters, and yet sufficiently high to drive the oil over. For this reason the best French retorts were cylinders which were caused to revolve slowly over the fire. The volatile matters make their exit through one of the axles upon which the cylinder revolves. The temperature needed is less than a red heat. Two and a half tons of coal, which is the amount that can be employed at a time in a retort eight feet long and six feet in diameter, may be distilled in six hours. The apparatus is liable to the objection that much of the content is reduced to dust, which escapes with the vapours and demands additional means of purification. The vapours are condensed in iron cylinders, where the water and oil are separated, and the gases escape either into the chimney, or are led into the fire under the retort.

The crude oil thus obtained is purified in the same way as ordinary Petroleum. It is re-distilled with increasing temperatures, 600° or 800° being eventually reached, in order to drive over the paraffine. About ten per cent. of impurity, including a very dense coke which is afterwards used in the fires with anthracite, remains in the still. It is next subjected to the action of five or six per cent. of sulphuric acid in vessels of three thousand gallons' capacity, called "agitators." After coming to rest the impurities settle to the bottom, and they are then drawn off and the oil washed with water, which in the course of a few hours is withdrawn. In the same way it is treated with potash or soda lye, and is then ready for the final distillation which separates: first, a very light oil; then, the illuminating fluid; then, the heavy lubricating oil; and, lastly, those parts which contain paraffine. The best illuminating oil is that of a light yellow colour, although the perfectly clear and colourless specimens are more valuable commercially.

A suitable vessel for transporting Petroleum has long been a desideratum. In the neighbourhood of the Burmese springs there are places where earthenware vessels especially adapted to the purpose are made in immense quantities. An ordinary barrel, although tight enough for other liquids, fails to prevent leakage of this very penetrating fluid. It is said that a barrel filled with naphtha will empty completely in two months. The escape of Petroleum in its journey from the wells to New York city, amounts to ten per cent. For transport across the ocean tanks lined with zinc have been used, to avoid the loss, some of the earlier packages sent having entirely discharged their contents. A recent patent claims to render the wood entirely impervious, by soaking it on the inner side with soapsuds, and coating the outside with boiled linseed oil containing drying materials. Iron cylinders have also been proposed.

These are some of the facts known concerning this singular substance. They have been related because of the extreme importance that it has attained as a source of wealth, and the comforts it has brought into domestic life. It has also ministered to the luxury of the times in adding to the number of the beautiful dyes produced from similar hydrocarbons—"Humboldt" and "Azurine" shades of blue, and "Rosina" having already been discovered in a refinery near the wells. It has entirely displaced whale oil, and has struck a fatal blow at the prosperity of the seaport villages of New England engaged in the whale fishery. The dangerous compounds of turpentine and alcohol—camphene, burning fluid, &c.—have been driven out of use by the cheapness, non-liability to explosion, and steady white light of this the best of all illuminators, gas alone excepted. Europe has coincided in this opinion with America, as may be seen by referring to page 521 of this Journal for July, 1864, where the export for 1863 is stated at 28,000,000 gallons. One firm has received an order to the value of 20,000*l.* from Russia, for the lamps in which it is burnt. The illuminating oils, too, have great detergent properties, and enable a person to remove many impurities, such as grease and metallic dust from the hands, when other means have failed entirely. For this reason some manufacturers incorporate them

with their soaps. Optically, they are interesting in not being exceeded even by sulphate of quinine in the fluorescent phenomena they present.

One development more is alone required to complete our indebtedness to these distilled products of bituminous fermentation. It remains to bore for gas to light great cities. In China this has already been done, and never-failing supplies are said to have been secured from wells three thousand feet deep. In one case, too, in the State of New York has the same result been reached. There must be prodigious supplies of oil and carburetted hydrogen locked up somewhere to the east of the great coal-fields of America. It should be remembered that, under a large part of the sixty thousand square miles where these deposits exist, only anthracite is found, the volatile matter having escaped.

ON METAL MINING.

By Dr. R. ANGUS SMITH, F.R.S.

ON our first visit to a mining district, we passed near a manufactory of blasting-powder. In a day or two an explosion occurred in it; much of it was destroyed; two or three persons were killed—young girls, if we remember well. There were only few persons at the works at the time. The neighbours informed us that the manufacturer had discovered a safe mode of making the powder, and that this was the third explosion that had taken place in two years! We did not inquire into the truth of these latter statements; as to the first, the newspapers gave the half-forgotten details.

We entered a mine, one of the higher class, and descended in a skip with a mining captain, who certainly inspired respect and confidence. We arrived below safely, and again rose in safety. The motion was remarkably easy, or rather quite imperceptible. We sank a thousand feet in three or four minutes, but we could not forget that our heads were uncovered, and that the slightest fall from the top or sides was sure destruction to us. Next day or nearly so the rope or chain, we do not know which, of a similar and neighbouring skip broke, and two men, packed together as we had been, were dashed to the bottom.

Our skip had a safety-catch. Had the one which fell? We cannot say. We entered Botallack mine. This journey was made in a char-à-banc of iron, which rolled down an inclined plane; and whilst we lay swathed in white flannel, and with candles in our hands, rushed through the hardest rocks, against which we were in constant danger of striking by the mere act of holding up our heads. Our candle went out, and we were left nearly in darkness. Captain James retained his light, but it was only enough to show how dark and hard-looking the projecting rocks were that threatened us as we rolled rapidly down under the sea. We came up safely; the patent catch was in order,

lest any accident should happen. We met a gentleman skilled in mines, and described the journey. "You actually went down," said he, "supported by a chain with single links? I would not have done it." We shuddered at the thought of one link among the hundreds being unsound, but then thought of the safety-catch. After we had left the district, nine miners went down in the same carriage with the support of the same link-chain and safety-catch; that one feeble link gave way, and all these men were killed!

There are other ways of descending mines; and we inquired as to the ladders. They were said to be 15 feet in length, each with a little projection for resting on. On close inquiry we found that this projection was not always placed, but the ladder simply continued to at least 60 feet, and that strangers sometimes, in the very midst of their ascent, would become transfixed; incapable of moving in any direction. For a moment they pictured to themselves their real position, which was that of standing on a ladder four times higher in the air, than St. Paul's ball and cross. The darkness hides this terrible fact, but the keen imagination sees through the rocks, and the result is the same as in the light. Probably no man could make the journey daily if he saw such a depth below him; darkness makes him appear to be rising only a few steps, although these may be often repeated. The mind must conform itself to the physical darkness, and not trouble the feelings by throwing a light on the scene, which, although purely that of thought, is almost as dangerous as would be the sunlight.

There are various kinds of stairs; some, when the inclination allows it, are merely boards with cross pieces to prevent slipping. These are often easily ascended, but in coming down there is much difficulty felt. We fear that in this country there is less attention paid to having railings as a support as well as safeguard. Along the footway there frequently runs the drawing-shaft, where the rough ore is drawn rapidly in boxes, out of which pieces frequently fall. When the shaft is confined, spiral stairs have been formed, but we do not receive information* on this subject. To mount a spiral stair in an old tower much above 100 feet high is fatigue enough for most persons, if it is not also productive of giddiness.

Another mode of descent is by the *man-engine*, which is a novelty to most men, although it is thirty years since Dörell invented it, in the Harz, and used it at Spiegelthal. We like to commemorate the names of inventors, and should have preferred to call this a "Dörell," if man-engine had not been so appropriate.

This ingenious invention had a most miserable appearance at first. To make the descent by it we were led to a small, broken-down hut, standing apparently alone. Inside of it were several miners, with their candles in their hands. The candle is held in soft clay, which serves as a candlestick. It is extremely flexible, takes every form, and clings

* This refers to the Report of the Royal Commission appointed to inquire into the condition of all mines in Great Britain to which the provisions of the Act 23 & 24 Victoria Cap. 151, do not apply, with reference to the health and safety of persons employed in such mines, 1864. The pages refer to the epitome of evidence.

THE MAN ENGINE;
for the descent and ascent of miners.

to a wall, which, however perpendicular, holds this candlestick as securely as a table. Seats were placed around the walls, and in a corner stood a beam four or five feet high. On this beam, and on a level with the floor, was a board 14 inches square, filling up the greater part of a hole which was in the floor. A man stood on this board and held by the beam; the whole went slowly down, and the head disappeared under the floor. Looking down there was an endless abyss, and small lights glimmered in the darkness. We took our stand on the board, and holding the beam descended. After going 12 feet the beam stopped, and our careful conductor said, "Step to the left." We stepped to the left, and stood on a board which was fixed to the side of the shaft, when the beam and the board on which we had previously stood rose up 12 feet to its first position. This brought another step, to which we passed, and the beam and step now went down other 12 feet, and we again stepped to the left and stood on a fixed spot. We had now descended 24 feet, and by constantly doing this arrived at the bottom.

In the plate (Fig. 1) the left-hand man has just got off the man-engine—he is going down; the right-hand man is stepping on—he is going up. By this means the same machine allows one to ascend and another to descend. There is the footboard every 12 feet on the moving-rod, which reaches the whole depth of the shaft, and at the same intervals of twelve feet there are fixed standing-points right and left. At Dolcoath this machine goes down 220 fathoms. Every two fathoms you must step on and off the engine, equal to 220 steps. There may be a man on every step from the bottom to the top. Strangers are taken down in about forty minutes, making a step every eleven seconds; but the usual time is about twice as fast, or one in six seconds. There is an iron handle by which to hold on to the beam. This is seen in the plate (Fig. 2), which shows the side-view of a man on the man-engine. The same number of steps is made upwards, making 440 in a day. Ladders with steps 10 inches apart would, with little inclination, require fifteen times more steps, or 6,600 steps for the same depth. In addition to this, the weight of the body must be drawn up and carefully balanced by the skilful and powerful use of hands and feet. When men come up by the ladders they are fatigued according to the depth, and painful accounts are given of some who sink down in dangerous exhaustion at the moment of coming to the surface, or fall from destructive heights. The men shoot out of that bare floor head-foremost in the dingy hut as cool as when they went down; perhaps too cool, for the shaft has a good deal of draught. At any rate they are not fatigued.

The man-engine is certainly capable of being made most agreeable. At the time of its origin in the Harz mountains it was a much more dangerous affair, and even now it is not permitted to novices. Here we have heard of men and of boys falling down and being crushed. There is a most remorseless grinding motion, and attention must not relax for a moment. The landings are sometimes cut in the rock, and the muddy rock is slippery—horrible thought. Sometimes they are near the platform for a ladder-way which goes along side, and the

opening for the ladder seems to be the only spot on which you can step; you must look carefully. Once we were struck behind on the hard rim of the hat; the rock itself had done it, and we were thereby informed that we must keep the head close to the beam, and not stand quite so much at our ease as the men do in the plate. At another time we were struck on the right elbow, and then on the left, and thus with authority informed that we must keep from the sides. These are all evils easily remedied. The hard rim of the hat is a great protection to the head; this is the cause of its constant use in mines, a lesson to those who too severely depreciate our common head-covering which has saved many lives.

We have shown the single man-engine. The double one has no steps or platforms on the rocks. There are two rods with steps, exactly like that seen in the centre of Fig. 1 and on Fig. 2. One faces the other: when one falls, the other rises. The man leaps on the steps, not exactly as it passes by him, for it stays an instant to reverse the motion. We may go in this way at double speed. There is one put up at Mariemont, in Hainault, by M. Warocqué, which seems to give greater protection to the men, who are not brought in contact with the side of the shaft. The mechanism is ingenious, but need not be described here.* The price of this engine, steam engine included, was 20,000 fr. for 228 metres; 32,000 for 600 metres; say 800*l.* for 114 fathoms, or 1,280*l.* for 300 fathoms. A fathom is not quite two metres.

Advantage of the man-engine.—Mr. Croch says, "A man was working in Wheel Reeth in a very close end, and disease of the chest was coming on; he went to work where there was a man-engine and recovered. He and others also recovered much more rapidly than men who were put into better air, and still did not use the man-engine."

Captain Stevens says, "Before we had the man-engine, we could not get men above twenty years of age to go down to the bottom of our mine." Now there are men up to sixty.

Captain Daw says, "They would rather stay down two hours than climb up from the bottom of the mine." They get more experienced men now, and fifteen per cent. more labour.

Captain Stevens considers that in all mines a saving of a quarter is made by the engine; in deep mines still more, in shallow mines less. Others consider that a man-engine will not pay itself unless the mine is 100 fathoms deep.

Objections.—The objections to the man-engine are its expense, being ill-fitted except for well-established mines; that it demands the constant attention of the men; if they make one false step it is fatal. Is human nature fit for such exactness? and what class of men, or what individual, is capable of passing through life without one mistake? However wearied, these men must be on the alert, and perform exactly every six seconds an act on which life depends. As to the first objection, we cannot expect a man-engine for every new mine, but every new mine does not require it. The beginning cannot be deep. The

* See 'Exploitation des Mines.' Par M. Ch. Combes, vol. iii. p. 176.

expense of sinking to great depths is so great, that the additional amount for an engine appears but slightly to increase the capital required, whilst it enlarges the income, according to the evidence.

As to the constant attention, it certainly is not less than is required on ladders, although perhaps a dreamy person may forget his way, and at any rate the man-engine of Warocqué removes much, perhaps all, this difficulty. The speed is less than that of the skip, although greater than the ladder.

Stemples.—Opinions generally are, we think, against them, and to us the practice of using them for a great depth seems inhuman. A man goes up with his arms and legs stretched violently out, and a black gulf yawns below; under him and in the gulf his son goes also, hanging partly by a rope by which his father supports him. Some advocates are found even for this.

Ladders occupy much of the time where the mine is deep. At 260 fathoms about an hour and a-half is occupied in going up, and about half as much in going down. The men are anxious to arrive at the top, and strain themselves to the utmost. The young run up for a few years only. Their time is paid for as labour in some cases, but not apparently in all.* A miner says, "They do not care much for forty or fifty fathoms unless the air is bad, but they feel the climbing of ten fathoms in bad air." "To come up 300 fathoms, it being very hot down, is a tolerably tidy day's work itself," says Captain Rutter. M. Dunstan says, "I have known men in West Cornwall who died on the ladders. They have come up to the top of the ladder, and then dropped down suddenly from disease of the heart brought on by climbing." Mr. Christopher Childs and others consider that climbing in bad air, not climbing *per se*, is hurtful.

From a comparison of the amount of work thus performed, with the results of climbing in the open air, as practised in other trades, it would appear that the actual climbing of the ladders, if performed with moderate speed, and not so long continued as to hurry the circulation and respiration injuriously, would be no further grievance than that of wasting time and imposing needless toil; with the important exception, indeed, of exposing the men to great danger of catching cold after being overheated by such great exertion. But either speed or long continuance at one time of such exertion will increase the exhaustion at a very rapid rate. Horses may be driven gently twenty miles a day without injury, but they will soon be worn down if driven too quickly half the distance. As every coachman knows, it is the pace that kills, it is not exertion but over-exertion that does the mischief. The captains of mines, who climb as much or more than the men, do not suffer, because they do not climb so much at one time, and because they have not other hard work to do as well. They seldom climb from a great depth at once, but break the toil, stopping to examine the different levels on their ascent, and they therefore suffer far less from overstraining of the lungs, and over-exercise of the heart, than miners, who climb the whole depth without cessation.

* See No. 2,840 and 19,529 questions.

The evidence of the miners themselves is sufficient to show that something connected with the climbing is injurious. Nearly vertical climbing in the purest air causes violent heart-beating. It is probably a question of intensity; for example, you may burn a ton of coals in keeping a piece of iron warm for a month, but if you burn the same amount in an hour, you may melt the metal entirely. So with the ladders: the peculiar position encourages violent exertion. To rise 300 fathoms on a sloping hill in an hour and a half is a tourist's pleasure, and yet the length is added to the height. The evil must be partly mental, a constant strain on the attention, such as the fatigue a man feels after passing great danger.

The evidence is overwhelming against long ladders, whatever the explanation.

Skip.—The mode of access that seems to be the rival to the man-engine is by the skip. This rises from the lowest depths in two to three minutes; at South Frances mine, four or five, to 150 fathoms. The skip is an iron box with guides, so that it does not swing like the bucket. There is more time saved by this than by any method, and less trouble is given. The position is very cramped, you cannot move an arm when two are present. Captain Trahair says, "There ought to be a sort of bonnet over the men's heads;" we felt seriously the want of this. Captain Boyns does not think skips safe except in perpendicular shafts, being apt to go off the line. They are used in shafts which may not be quite perpendicular in their whole course.

The skip, according to Mr. Richards, costs 1*l.* 10*s.* a fathom; the man-engine 3*l.* 10*s.* When a chain breaks over an uncovered skip, it falls down on the heads, and even if the catch holds, there is no safety.* The safety-catch seems successful, but not always so, still this is clearly in the power of man. Shall we trust to the care and memory which may fail once only during a life, or to the skill of the workman; to the mind or to the machinery? A safety-hoist in Manchester fell, because a pin had been forgotten, and was fatal to one or more persons; it was safe only when all was in order. A few years ago, Mr. Binyon insisted that the hoist in his sugar-works, now belonging to Messrs Fryer, Benson, and Forster, should have six ropes, each of which should alone suffice for safety, and indeed, if anything went wrong, it was a question difficult to answer, whether the hoist would go up or down, it was so well counterbalanced. So admirably has this plan answered, that the one rope, in at least six years, has never broken or required changing. The conditions may be different from those in the mines, but a useful idea may be perhaps obtained here.

Capt. Pascoe and Mr. Cady say that it costs 4¾*d.* to lift a ton of men or of stuff 150 fathoms. They use Bennett's patent catch, and a wire rope. The men can come up in two minutes; and without a skip, they would require half an hour's climbing. We may here remark that if 150 fathoms can be ascended in half an hour, whilst it requires one

* On writing this on the 19th November, 1864, we read that eight men have yesterday been killed in this way, the skip also fell.

hour and a half to ascend 260, as elsewhere said, it would show that after the first half-hour the progress is nearly three times slower. 260 − 150 = 110, which ought to be ascended in twenty-two minutes, whereas it takes sixty. The old men, it is added, would sooner work half a day than climb that depth.

The chairman of the Commission, Lord Kinnaird, says,* "It has been suggested that there would be a difficulty in sending down a sufficient number of men by a single skip; but if you could send such a carriage containing nine or ten men, as in coal mines, would not that surmount the difficulty?" "Yes; but our shafts are not so large," says Capt. Pascoe; "and therefore we could not have a platform large enough." Lord Kinnaird says, "Could not the men stand one over the other, in tiers?" "Yes, it might be done very nicely, I think." A skip for stuff brings up at present about 15 cwt., which is equal to ten men.

At South Frances, forty men go up and down in one hour. Six go in the skip at a time; it takes half an hour for all. Some have to wait; but they would only gain their fatigue if they went before, as they would not arrive sooner. The skip is a most convenient mode of raising up wounded men, and the rapidity of assistance may often save their lives. There must, however, always be a ladder-way, in case of accident either to man-engine or skip

Chains.—We may inquire whether we should go down by a rope or by a chain. M. T. E. Forster, Newcastle, says, "I would never go down upon a chain." He always uses wire rope, and changes it as soon as the outer wires are worn. He has it examined two or three times a day, and throws it away three months before he considers it to be done. He thinks it better not to depend on safety-catches, as by such dependence men feel less the importance of attending to the machinery. He uses cages, and in seventeen years no accident has happened in going up and down. We can desire no more than this. There may be more difficulty in metal mines, *but the problem of entering mines safely seems to be solved*, and the question is, "By what means shall the method be brought into universal practice?"

Shall we leave so much to men? It is said, and truly, that after all the genius of our engineers has done its part, our lives are left at last to a pointsman. He certainly is the most wonderful of machines. The real truth lies on both sides. We must see that the machinery is right, and then trust to the men; but finally we shall find that we must trust to men to see that the machinery is right, and the men also right: in other words, the more intelligent and trustworthy the oversight is, the greater is the security, and we come again to the old subject of education.

Care in Miners.—We went to a mine (not in Cornwall), and although only a bucket could be had, we wished to go down. It was needful, we were told, to wait a little, as "the usual man is not here." "Where is he?" "In bed." "What is wrong?" "He fell down

* P. 32.

the pit." "Why did he fall?" "The rope broke when he was about 30 feet from the bottom." "Another man that helps will take you down, and use a new rope." An old hemp rope, much mended, had been used. We did not go: if the most skilful man around had made such a blunder, what would the second do? If we swing in a basket 400 feet above the earth, we shall see that the man who holds us has not only some education but some common sense!

On this point we must say a word. We imagine that in these days, information goes from place to place instantly, but it is quite curious to hear the Cornish people speaking with fear of cages, such as are used in the coal districts, and of the Northern people equally dreading skips and ladders! We require men who know both plans, to give their opinions. It certainly is most fully done *vivâ voce*. Bigotry is not confined to religions. It is hard to say what class of men have least; we are all very liberal when dealing with subjects to which we have not attended much, but very severe burners of heretics when our own notions are assailed. If we had power to decide on the plan to be adopted for entering all mines, we could not do so from the evidence, but should say, "If men can be lowered and raised for seventeen years without any one injury, is it much to require that every mine should have its work done equally well? Take your own plan, but give us this result."

Work in the Mine.—When a shaft is sunk vertically, the miner tunnels forward, keeping on the same level. He makes long galleries. Mines of copper, tin, and lead are often found in extremely hard rock. The hardness and the rate of progress vary exceedingly. The rock is bored by long tools resembling chisels, struck with hammers about 8lbs. in weight. One man holds the borer, and another strikes. This is laborious work, and the position is often very cramped. The borer must be frequently turned round, the rock is ground to dust, and as such is drawn out. The hole is filled with blasting-powder, then covered with some soft material and beaten down or tamped. If this were not done, the explosion would displace nothing, the entrance must resist as much as the rocky sides.

Some persons beat down the powder without any cover to it; many accidents occur in this way. Frequently, the powdered rock or dust from the bore hole is used; sand or dry clay also. Capt. Phillips recommends clay, and it is certainly softer than sand. All agree that large pieces of grit or spar are dangerous. When we strike gunpowder with a hammer on sandstone, an explosion follows readily. It requires no powerful blow. This is much easier when on stone than on an iron anvil. To use sand, and to beat this with iron, seems to invite explosion. A fine soft clay will not, as far as we know, cause the same, and the fine powdered killas, as soft as flour, spoken of by Mr. Puckie, may be as safe. Hemp, tow, or cotton are also used.

It may be asked, is it needful to strike the first layer of tamping at all; is it not enough if the upper part be firmer, whilst the powder itself may only be slightly pressed by the soft tamping material. We

could then increase the power of the blows till the last layer was added.*

At present, violence is often used from beginning to end; and there are different opinions as to the proper use of it. All agree that the hole ought to be wiped out with a swabstick or wet rubber to remove all grit. Some put the powder in a case or cartridge, and others a mere covering of brown paper. Capt. John Webb took a patent for a case with a wadding of cow hair as a foundation for the tamping. This soft material seems a move in the right direction.

In many places, it is directed that the first blows shall be given with wood, and sticks are provided for the purpose, but the men pay no attention. In other places, copper rods have been tried. The commissioners recommend the use of bronze tamping rods. Lord Kinnaird has had one used for a year, and has found that it wears well, and is safe. It may be supposed, however, that we must not even use these on the bare powder or with much grit.

If the tamping filled up the hole entirely, the powder could not be ignited; there is, therefore, a fuse inserted, made of a slowly burning mixture. This must be in a tube strong enough to bear against the pressure of tamping. If the tamping material is hard, it may break the tube, which is made sometimes of canvas and tar.

Before beating the tamp, it is needful to clean the mouth of the hole with a wet substance, a swab-stick to remove all loose particles of gunpowder: neglect of this is often fatal.

To tamp properly, one man is sufficient: he holds the rod with one hand and strikes it with a hammer in the other. In doing this he feels his way, and if any hard substance intervenes he can take precautions. When one man holds and another strikes, as in boring, such violent blows are given that there is great danger, from a want of sympathetic action between the hammer and rod. This habit is forbidden. In some places this or the neglect of wooden rods is punished by the refusal of relief from the club in case of accidents.

Now the fuze is lighted and the men rush off into corners. They wait anxiously for two minutes; sometimes there is no explosion and their labour is lost. If they have prepared three holes and only two go off, they are much chagrined. The rule in some, if not all mines, is that no man shall go near a hole in this uncertain state until next shift. This rule is valuable; strange chances prevent the timely explosions, and many a man has been blown back who rushed too hastily forwards to seek an explanation of a delay which, after all, he had merely imagined as he was standing alone in his dark corner.

We remember seeing an instance of this haste. We were exploding some gun-cotton, a dozen men were near, and when above the usual time was past, several rushed forwards. The cautious men were not among the workmen; some called out, "Wait longer," ann well it was, because after waiting nearly double the usual time, the explosion occurred. Why was this? Some interruption in the fuze; some of the mixture, perhaps, a little moist, or containing less powder, so that it burned more slowly than usual.

* See Captain Boyn's evidence.

We have described two operations, entering the mine and working in the rock, at some length, but when they are well considered, they will render the remaining portion more intelligible. When the explosion is made, the miner rushes to it with his candle, he is anxious to know what treasures have been sent to him from the hitherto invisible world, and if he has taken the work for himself he is doubly anxious. Yet why should he go? he must not remain, as the smoke blinds and chokes him, helping also to extinguish his light; he is obliged to return and sit down half an hour till the smoke clears away. This is idle time, and in a mine there is a good deal of time that may be spent without violent work. To avoid this difficulty of measuring labour, the plan of tribute work is sometimes adopted. The men make offers for a certain piece of ground and take their chance with it.

We must not lose sight of the blast. When the rock splits it may strike persons not carefully stationed, and when some portions are displaced, others may fall and do grievous injury. These are accidents of no uncommon kind. Even when the loose rocks are of no value, they may be taken up to the surface so as to get rid of them, but they may also be used to fill up spaces that have been worked out, in which case, they are built up like walls. These walls vary as much in construction as do the Pyramids and an Irish cabin. Some cannot bear touching; other places have great masses supported by wooden beams, and this wood decays. There are walls also built with the greatest firmness, neatness, and security; this is remarkably so in German mines. The long galleries are called levels, but more properly speaking a level is a story, with passages in it. A shaft may lead to a story lower, and there may be shafts communicating at various points, with these levels or stories. These shafts are called winzes. When you are moving along the passages, careful that you should not strike your head against the roof, you are told to mind your light; as the water is dropping, you feel the rain and become attentive to the candle. Then you are told to mind your feet, as it is very wet, but you become reckless and step into any depth of mud. Then you are told to be attentive as there is a deep hole, a shaft or winze near, and only a plank across it, not a very safe one; or perhaps it is the mouth of a sump or perpendicular cut. You immediately attend to the plank, but no, you must not forget your head. Persons rush forward looking to their feet, and dash their heads unhappily. We must watch the rocks above and below, with our elbows feeling the wet sides, and our hands on the candle, ready, however, to grasp the plank should we trip. There must be no inattention when walking through a mine. You pass this hole and move on, you find that the current of air made at the opening ceases entirely; you see no way forward until you are told that the heap of stuff lying in the way does not reach quite to the roof, and you have room to crawl over it and reach the other side. Up to this time you may have fancied that you were keeping yourself moderately free from the mud around you, although your hands were covered with clay, and the candle-grease had mixed with it, but here you relinquish all such ideas, and abandon yourself to your fate. No miner comes out so brown as you,

and none so badly taken care of, although you imagine that you have been all your life accustomed to cleanly habits.

All these conditions produce dangers sometimes fatal. The dangers to which workers in mines are subject, are as follows: *—

Falling down the shaft, &c.: Uncovered winzes, sumps, and holes; rotten or broken ladders; fatigue; falling from the steps of man-engine; from the skip or carriage slipping off the guide; the breaking of chains and ropes; falling through winzes not covered.

Beams, &c.: From the falling of walls and heaps, stone or kibble; from the lifting part of the shaft not being divided from the road-way; from the rotting of wood, or decaying of props.

Explosions: Caused by careless tamping; hasty return after lighting; fall of rocks.

Air: From powder, smoke, and dust of the exploded rocks; from candle smoke and bad ventilation generally; from stagnant air not lately entered.

Water and temperature: Neglect of health and life laws; constant exposure to moisture, to hot air, and to cool currents.

Heat of the mines, &c.: Long distances to walk home; sudden changes at the surface in wet clothes; sudden irruptions of water, from the old pits not well covered at the surface; working out of doors at surface work in all weathers.

From being made to work in the mine too early in life.

From bursting of boilers.

Inquests are held after violent deaths, it is true, but the coroners and the jury seem alike to be imbued with the spirit of the place, and the frequent verdict of accidental death, although so far correct, neglects to say that such accidents are avoidable. We require to move nearer to the cause, and in most cases to make an accident itself into an offence. Accidents do not occur where there are sufficient precautions. Nearly all accidents are faults, amounting to crimes, arising from ignorance or carelessness, whether in mines or out of them.

We have thus referred cursorily to various points of interest connected with the mechanical means employed in metal mining, and to the immediate risks attendant thereon, as revealed by the recent Report of the Mining Commissioners. To consider, in addition, the equally important question of the health of miners, would occupy more space than can be devoted to a single article in this Journal, and we must, therefore, reserve our review of that portion of the subject for another occasion.

* See 'Report of Commissioners and Appendix.'

CHRONICLES OF SCIENCE.

I. AGRICULTURE.

During the past autumn, after several months of the long-continued drought of 1864, Professor Church, of the Royal Agricultural College, examined for water the thirteenth inch in thickness downwards from the surface of a clay-land field near Cirencester. Several samples of the subsoil taken from this depth were analyzed. In one case, where the soil had been deeply cultivated during the previous autumn, no less than 28·6 per cent. of the apparently dry layer examined, was water. In another, where the subsoil was taken from uncultivated land, which had not been disturbed within memory, the percentage of water was 19·2. In a third case, the subsoil of a kitchen-garden which had been deeply trenched in autumn, yielded 26·2 per cent. of water. In a fourth, the subsoil in the same garden, where the bed had been only half dug, yielded 20·5 per cent.

There had been no rain to speak of since the spring, and yet these enormous quantities of water still remained in the subsoil. The soil experimented on is "a light calcareous clay loam, resting on the Forest marble." These facts are instructive, both as showing the great storeage of moisture within the land, available during seasons of drought, and also as indicating to tillage farmers the greatly-increased capacity for moisture which deep and thorough tillage gives to land.

We mentioned last year the publication of Lectures on Dairy Farming, by Mr. Harrison, M. Inst. C.E., of Frocester Court, Gloucestershire. This gentleman having for several years kept a record of his dairy experience has reproduced it all by means of curved lines, representing the varying weekly milk produce of individual cows, and of the whole herd throughout the year. The annexed diagrams are prepared from his figures. They indicate the weekly yield per cow of the whole herd during the three years named. It is plain that if the weekly quantity of milk yielded by a cow were represented by vertical lines of correspondent lengths, stationed at equal intervals along a base line of sufficient length to receive fifty-two such lines for the successive weeks of the year, they would, in any ordinary case, where the cow had been kept in health and produce by a uniform method of feeding, commence at a maximum height, and gradually dwindle. The curved line joining their extremities, whose distance from the base line at the summits of the vertical lines thus joined would show the varying yield of milk from week to week throughout the year, would commence at once, perhaps some time in March, at a maximum height, representing possibly a produce of twenty, or two dozen gallons weekly: it would maintain a nearly level course till after Midsummer, and, gradually dwindling through the autumn, it would touch the base line, indicating an entire cessation of produce towards the end of the

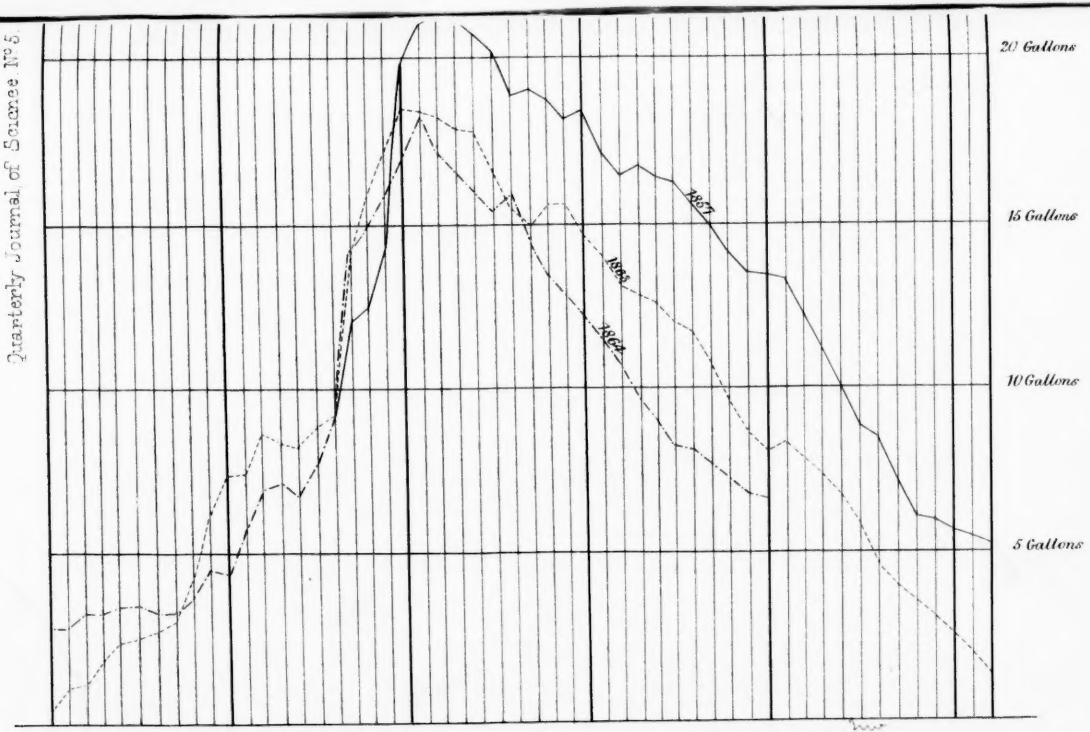


DIAGRAM SHOWING WEEKLY YIELD (DURING 3 YEARS) OF MILK PER COW.

year. There are, however, many things upon a farm which interfere with the uniformity of the curve of individual weekly milk produce. For instance, cows are not fed uniformly throughout the year. They generally begin with hay and roots, immediately after calving, not getting on to grass till May, and this grass gets short during haymaking time, increasing in abundance when the aftermath is available. Neither are cows in uniform health, nor is the weather by any means a uniform influence. All these things interfere with the uniformity of the yield of milk and with the regularity of the curve representing it. The curve given on the annexed diagram represents, not the yield of an individual cow; but the yield per cow of the whole herd; and here another item comes in to affect its character. Cows do not all come to the pail together, and thus the milk produce of a dairy-farm never altogether ceases. The curved line representing it, thus never altogether touches the base line. It rises rapidly during the spring months as the cows are calving, and as the green and succulent food of the pastures becomes available: it rises to a height dependent on the dairy character of the herd, and the abundance of the food supply; it falls occasionally, with more or less regularity, according to variations of temperature and of food and health. All these particulars are observable in the curves before us. The curve of 1864 is not so high as usual, owing to the deficiency of food in the fields, which the drought occasioned. The curve of 1863 shows a remarkable depression during autumn, owing to an attack of the distemper from which the whole herd suffered for several weeks. Occasional depressions seen in others of the curves, which are owing to bad weather, will probably be found paralleled in the annual temperature curve of the time, if it be examined. And every one of them exhibits more or less of a depression during June or July, when the food supply suffers just before the aftermath comes into use. We give these diagrams to illustrate both the quantity of information which may be thus conveyed to the farmer, and the intelligence which is now brought to bear upon the varying experience of the farm.

The utilization of London sewage is again occupying attention. Baron Liebig has written to Lord Robert Montague, who had obtained a Committee of the House of Commons for the consideration of the subject, to declare that it is not a complete manure, but must be supplemented with additions of phosphate of lime and other ingredients, according to scientific recipes, or it will soon create as much agricultural disappointment as it is now exciting hope. Sewage is deficient in phosphoric acid, and therefore, says Baron Liebig, although "on a soil rich (in its natural state) in phosporic acid, it will have an excellent effect, producing, for instance, large crops of grass, turnips, and corn, if the soil supplies the quantity of phosphoric acid wanting in sewage, yet as in each successive crop, a certain quantity of phosphoric acid is abstracted, the total quantity is by the continual application of sewage gradually diminishing every year, and a time must come when the phosphoric acid is insufficient for further crops, and when sewage ceases to produce its former effects." Accordingly, "for each crop the composition of the sewage ought to be corrected according to the

nature of the soil, by adding those ingredients which are wanting in sewage, and which the plants to be grown require in the largest proportion."

We are not at all likely to see the time even in our little country, where agriculture is progressing from year to year, when crops shall be cultivated with success by the aid of scientific recipes. Whether sewage be a lop-sided manure or not—and we suppose it is incomplete, to the extent, at any rate, of a definite quantity of bones, it is certain that its weakest side possesses, in the quantity which should be applied to land, superabundant strength.

The Craigentinny meadows, below Edinburgh, which have been irrigated with sewage water for a century or more, have continued to yield 30 to 40 tons per acre, a produce for which Edinburgh cow-keepers are content to pay 20*l.* to 30*l.* per annum. And on the lower part of them, more recently reclaimed from the sea-shore, where the original fertility of the land was absolutely nothing, the produce of grass is as abundant as anywhere else. It is plain that Liebig's letter has been written in the interests of that particular scheme for using London sewage, which proposes to take it over many hundred thousand acres, and distribute it at the rate of 2*d.* per ton, or thereabouts, to the farmers, who will, no doubt, want something, whether compounded by the chemist or not, to supplement the two or three hundred tons per acre, with which it is believed the land will thus be fertilized. The other scheme, which proposes to irrigate a comparatively small area, has all the agricultural analogies in its favour. Craigentinny, Croydon, Rugby, and Carlisle can all be quoted in its favour. Meanwhile, there are 100,000,000 tons per annum now running out to sea at Barking, and it is a shame to the agriculturists and commercial men of England that such a mass of fertilizing matter should thus run to waste.

The proposal for turning it to use, which the Metropolitan Board of Works has sanctioned, and which will come before Parliament this spring, includes the lifting of the whole some 40 or 50 feet by pump, and thereafter letting it flow along a channel down to the south-eastern shore of Essex, where there is a great tract of foreshore left dry at low water, ready to be embanked, and fertilized. The *Oxford Journal* thus describes the plan :—

"There are several special advantages connected with this scheme for the utilization of London sewage which must not be forgotten. The district where it would thus come into use is not a residential district. The country which would thus be fertilized is very thinly populated. And any nuisance which might be created would thus affect but very few. Again, at the end of the forty miles of line, there is a tract of foreshore—the Maplin Sands and the Dengie Flats—where 20,000 acres or more might easily be embanked from the sea. So that here we have at once an estate to be fertilized, where every 10,000 tons of sewage may be converted into 30 or 40 tons of grass, and this into about 5 or 6 cwt. of meat, or a corresponding value of milk, which will be sufficiently profitable both to tempt and pay expenditure. There would thus be an outlet at once for this 100,000,000 tons of sewage ; and this poor land, which would need at first enormous supplies of fertilizing matter, might thus for a

few years receive nearly the whole of this enormous quantity. In the mean time all the low-lying land along the course of the new sewage river would gradually be receiving a portion here and there, as its tenants realized the advantage of the dressing, and ultimately, in all probability, only a portion of the material would reach the terminus estate, which would, however, by that time be in a condition to do with less. And at length, no doubt, if the supply should exceed the demand for both these purposes—reservoirs might be obtained here and there along the line, into which pumps will deliver portions of the manure, so as to command the higher land, for which a portion of the sewage may be wanted.

"It seems to us that the South Essex scheme—using the sewage in the district towards which Mr. Bazalgette's channel already takes it—using it in a district where the nuisance it will create must be a minimum—taking it along a line where cheap land is to be had, to a terminus where an absolute waste exists, which may be enclosed and fertilized—is most in accordance with the existing experience in the use of sewage. In its terminal enclosure, and the long line of suitable country which may ultimately be benefited—it combines all the elements of ultimate success."

The drought of the past season has resulted in an unusual failure of the turnip crop; and considerable difficulty is thus experienced in providing food for the live stock of the farm through winter.

The prices of meat and wool are, however, such, that the large expenditure in grain and meal, and the refuse cakes of the oil-mill for feeding purposes, will prove profitable; and it is hardly to be doubted that the large experience in richer feeding which is thus forced upon the farmer, will gradually lead to a larger meat manufacture generally upon farms in seasons of greater productiveness, and thus, through the larger dung-heap of the farm, to increased fertility.

II. ASTRONOMY.

(*Including the Proceedings of the Royal Astronomical Society.*)

The science of Astronomy is ceasing to be so exclusive, and now draws important aid from other branches of natural science. Putting out of the question the assistance which the optician and his science have always given, and which has been abundantly repaid in the important knowledge concerning the laws of the propagation of light, which has been reflected back by astronomy, we may instance the wonderful contributions to our knowledge of the composition of the heavenly bodies which has been yielded by the spectroscope; the share which chemistry has in the spectrum discoveries, and also in the composition of meteorites, and the deductions derived therefrom; the application of photography to the delineation of the conformations of lunar, solar, and planetary surfaces, and the positions of fixed stars; and, lastly, the great service which electricity is doing for the practical astronomer in recording transit observations. In nearly all these branches we have something of value to communicate, although in pure astronomy but little progress has been recorded since our last issue.

By far the most gigantic work that has appeared for many years has just been published, as the first part of the 154th volume of the 'Philosophical Transactions of the Royal Society;' this is the catalogue of Nebulæ and Clusters of Stars by Sir John W. Herschel, being a catalogue of no less than 5,079 objects, arranged in tabular form, giving, besides ample references, the Right Ascension for 1860, January 0, the annual precession in Right Ascension for 1880; the North Polar Distance for 1860, January 0; the annual precession in North Polar Distance for 1880, and a summary description from a comparison of all the observations, remarks, &c. The present catalogue is published at a most opportune time, as, should the efforts which are now making to procure for the University of Melbourne, in Australia, a reflector of the first magnitude prove, as is to be hoped, successful, it is understood that one of the principal uses to which it will be devoted will be the examination and exact delineation of the numerous and wonderful objects of this class which the southern hemisphere presents. The present work is a general catalogue of all the Nebulæ and Clusters of Stars actually known, both northern and southern, so arranged and reduced as to enable an observer at once to turn his instrument on any one of them, as well as to put it in his power immediately to ascertain whether any object of this nature which he may encounter in his observations is new, or should be set down as one previously observed. For want of such a general catalogue, in fact, a great many nebulæ have been, from time to time, in the 'Astronomische Nachrichten,' and elsewhere, introduced to the world as new discoveries, which have since been identified with nebulæ already described and well known. Many a supposed comet, too, would have been recognized at once as a nebula, had such a general catalogue been at hand, and much valuable time been thus saved to their observers in looking out for them again.

Mr. Lassell has offered to the University of Melbourne his four-feet equatorial, constructed by himself, at present in use at Malta. This magnificent gift has been accepted by that body, and it will, we expect, before long be on its way to Australia.

Mr. De la Rue has given an interesting account of his recent visit to Russia, in order to be present at the twenty-fifth anniversary of the Pulkowa Observatory, which is now under the direction of M. Otto Struve, son of the late director, M. W. Struve, of world-wide renown. Within the last few years great pains have been taken to test the accuracy of the instruments, it being desired that the observations made with them should give the *absolute* places of celestial bodies. The electro-magnetic recording of transit-observations has been adopted on a plan differing somewhat from that employed at Greenwich. In the first place, the tappet-apparatus is held in the hand, not attached to the transit, as at Greenwich; and when the observer sees a star enter the field, *he records on the registration-paper, as it is unreeled, the name of the star, expressed in Morse's alphabetical signals*; together with any remark he may think necessary; then, as the star crosses the wires in succession, the tappet-apparatus, moved by the hand, records each contact; and, when the star has left the last wire, any further remark

can be registered on the paper. During the time that the paper has been unreeling by means of a clock-work driving apparatus, the normal clock has recorded the seconds, and indicated the commencement of each minute on a scale of seconds placed parallel with, and in close juxtaposition to, the indications transmitted from the transit. The traces are made with diamond points on mat-black paper, which becomes burnished under their pressure, and shows two bright lines, which, the points being always on the paper, would be continuous, but for the interruptions of the current, produced, on the one hand, by the beats of the clock, and, on the other, by the operator's signals from the transit. These interruptions cause a sort of battlement, like that on a crenulated wall, to project from the lines, the commencement being the exact second, or the precise moment of transit, as the case may be. The reading off is perfectly easy, and is capable of great exactness, either by estimation or by actual measurement. The batteries used are Meidinger's modification of Daniell's, and give great satisfaction, the elements being copper in contact with a solution of sulphate of copper, and zinc in contact with sulphate of zinc, or sulphate of magnesium; and the two fluids, neither of which is placed in a porous cell, are kept in surface-contact.

A very great improvement has been adopted in the arrangement of the normal clock belonging to this observatory. Clocks vary owing to three causes. The first being unavoidable errors of workmanship; the second, the variation of temperature causing the pendulum to lengthen and contract; and the third the alteration in the atmospheric density, the pendulum meeting with less resistance while passing through the air when the barometer is low than when it is high. Horology has now been brought to such perfection, that it is believed that if the second and third causes of error could be compensated for, the first would be almost imperceptible. The temperature error is generally corrected by the mercurial cistern, but the far greater bulk of the latter and its contents in relation to surface as compared with that of the pendulum rod renders it impossible for the mercury to take up any change of temperature so rapidly as the rod; hence the rod varies in length far before the mercury can, by expanding or contracting, prevent an inevitable shifting of the centre of oscillation in reference to the axis of suspension. This serious defect in the mercurial pendulum has been guarded against at Pulkowa, by removing the clock which was formerly embedded in one of the piers of the central hall under the great equatorial, and placing it in a subterranean chamber beneath the hall, in a situation where changes of temperature occur very slowly, and where the limits of change are very narrow from one period of the year to another. The barometric error it is also intended to remove by placing the clock in an air-tight case, in which a constant pressure will be maintained by means of a pump to be brought into use whenever it shall appear from the indications of a pressure gauge to be connected with the clock case, that there is a variation in the density of the air around the pendulum.

Mr. De la Rue also describes a very ingenious method of communicating time signals for controlling other clocks by the normal clock

of Pulkowa. On the frame of the clock, one on each side of an imaginary plane, which would cut the centre of the crutch, are fixed two ivory cylinders, each of which having cemented in it a capillary tube of glass; these two capillary tubes are open and point to one another, and are connected with two reservoirs of mercury, so that a stream of that metal issues from each capillary tube, and these two streams uniting, form, as it were, a wire of mercury connecting the two reservoirs; and these reservoirs being connected with the respective poles of a battery the circuit is completed, and the current continually transmitted so long as the mercury-wire remains unbroken. The breaking of the circuit at the desired intervals is thus effected. To a prolongation of the ordinary crutch is attached a thin blade of mica, capable of adjustment as to position; and this blade of mica as the pendulum and crutch oscillate, cuts through the mercury-wire, thus breaking the circuit and causing the signal to be transmitted. The position of the mercury-wire and that of the mica-blade being capable of adjustment with reference to each other, break of contact can be made to coincide absolutely with the beat of the clock, and the duration of the break can be regulated by varying the width of the blade of mica.

With further reference to the subject of the transmission of correct time, Mr. De la Rue states that the Liverpool Observatory is about to be removed to the Birkenhead, or opposite side of the Mersey, so as to make room for dock improvement; but, in order that its great utility to the mercantile navy may not be interfered with, it is intended to place a chronometer room in a position easly accessible to mariners, and to transmit time signals to and control the clock of that establishment by means of electric communication with the normal clock of the observatory. Jones's system of controlling clocks has been for some time past successfully practised in Liverpool, where the value of accurate time is fully appreciated; and we all know that in Scotland the transmitting of time signals, either by gun-firing or by controlled clocks, has created a great sensation. London, however, is still deficient in this respect; and notwithstanding the admitted truth of the adage, "Time is money," and the proximity of Greenwich, accurate time is not obtainable at any public establishment, whereas one would imagine that in the City, at least, controlled clocks would be placed in the various centres of commercial activity. Mr. De la Rue relates that he can speak from his own personal experience as to the practicability of transmitting time signals, and controlling clocks by electric agency, for in his own works, Mr. Walker, in conjunction with Mr. Jones, has, by the kind permission of the Astronomer-Royal, placed a clock so perfectly under the control of the Greenwich clock, that unless there is some derangement of the wires, it beats for months consecutively, second for second, with the clock at Greenwich; and in case of an occasional variation, a signal comes four seconds after every hour, and furnishes a means of correction.

With a view to the determination of the parallax of the fixed stars, Dr. Winnecke, the vice-director of the Pulkowa Observatory, is having erected in a small observatory at a little distance from the main building.

an equatorial which can be clamped in any desired position in or out of the meridian, so as to remain immovable during the required interval. It is intended to observe the transit of groups of stars near together at different periods of the year, and to record the observations by the chronographic method. We thus perceive that the automatic method of registering astronomical phenomena, is step by step extending. There is a degree of proficiency beyond which no amount of training can carry human skill; and when this has been reached, it is a fit and proper development to call in the resources of the human intellect to devise mechanical contrivances which shall accomplish any desired end with a precision not attainable by human organs, however highly trained.

Whilst we are speaking on the subject of clocks we may mention that at a late meeting of the Literary and Philosophical Society of Manchester, Mr. Baxendell described a remarkable derangement of his sidereal clock caused by the earthquake which occurred on the 26th of September. At the same time he suggested a new method of registering the occurrence of earthquake shocks based upon this circumstance.

A new planet, making the eighty-first of the group existing between Mars and Jupiter, has just been discovered by M. Temple of Marseilles. Its brilliancy is that of a star between the eleventh and twelfth magnitude. The discovery has been confirmed by the observations of M. Luther, of Bilk.

An interesting illustration of the dependence of one science upon another has just been shown by the chemical analysis of the remarkable meteorite which fell at Orgueil. MM. Descloizeaux, Daubrée and Cloez announce the discovery in it of a crystallized carbonate of magnesia and iron; the meteorite containing a little more than one-half per cent. of carbonic acid. These are small facts but valuable, since the presence of this crystallized carbonate proves that the meteorite could never have been exposed to a very high temperature.

Proceedings of the Royal Astronomical Society.

Astronomers for many years past have suspected that there were changes going forward on the lunar surface. Indeed, five years ago, the Rev. T. W. Webb submitted to the Society a notice of traces of eruptive action in the moon, in which he drew attention to the spots Cichus and Messier, as furnishing probable evidence of the continuance of explosive force during the present century. The reverend gentleman has now made another contribution to this interesting subject, but owing to the imperfections in the great map of Beer and Mädler, the cases of suspected alteration now pointed out are by no means conclusive that changes have taken place. It seems generally admitted that no alteration of any considerable magnitude has taken place upon the lunar surface since the date of anything which can be called accurate observation; it is only in the smallest class of craters therefore that we can reasonably look for traces of continued activity; and

it is precisely *there* that we become sensible of a deficiency in the work of the illustrious German astronomers; in some instances we find these minute details laid down with less regard to accuracy of position than would have been desirable; in others we are inclined to question whether they actually represented all that their instrument was capable of showing them, and that they therefore might have seen, especially if they had been willing to avail themselves of the labours of their predecessors. A remarkable instance of this is to be found in the great plain recently termed by Dr. Lee the *Mare Smythii*, where Schröter's figure, under the name of Abraham Gotthelf Kästner, is much more faithful than their own; and another in the *Sinus Aestuum*, where their assertion that no craters are discernible, was afterwards retracted by Mädler, and never, one would suppose, could have been made had they consulted the design of Lohrmann. It is the unfortunate want of confidence in our highest standards thus necessarily resulting, which throws some doubt upon the evidence of change which Mr. Webb adduces, and renders an appeal to the future still necessary to render it conclusive.

Eight separate instances of suspected change are now recorded by Mr. Webb, some of these are certainly too doubtful to require more than a passing notice, but others deserve careful scrutiny from time to time and very accurate comparison with well-executed drawings, or if obtainable, photographs. We will give a short notice of the most noteworthy of these instances.

On February 8, 1862, the S. and S.W. slope of the magnificent ring, *Copernicus*, was seen to be thickly studded with very minute craters not represented by Beer and Mädler. The omission is chiefly remarkable as they form a continuation of the extraordinary assemblage of similar foci of eruption lying between *Copernicus* and *Eratosthenes*. This latter wonderful district, it may be observed, by the way has probably assumed its present honey-combed aspect during the present century, as it is hardly conceivable that in such a situation it should have escaped the persevering scrutiny of Schröter, and been left for the eye of Gruithuisen in 1815.

Another instance of probable change is afforded by the ring mountain *Mersenius*. This is remarkable for the very unusual feature of a convex interior, which was discovered and well drawn by Schröter, and appears then to have had no object upon its summit. It is represented equally smooth in the map of Beer and Mädler; and from their description, we are assured that this was no error in the drawing, for they speak of several inconsiderable ridges and terraces round the inner foot of the ring, and a general upheaving of the interior towards the centre, so that for some hours this bubble-like convexity casts a distinct shadow to the eastward in the increasing moon, and they have, though opportunities are not so frequent, seen it falling in the opposite direction; but they expressly add, that "a central mountain is totally absent." No further evidence can be needed to show that they had thoroughly investigated the spot. Now in the year 1836, the Rev. T. W. Webb perceived, on the summit of this well-known convexity, a minute crater, and several other delicate

markings. The aspect of a considerable portion of them is that of a line of long irregular ravines, without elevated margins, as though they had been formed by the dropping in of part of an inflated and hollow crust. We have here something that certainly looks like evidence; and it would seem as though the epoch of the supposed convulsion might be fixed within narrow limits; for the map was published between 1834 and 1836, while Mr. Webb's first detection of these objects took place in 1836. The value of this evidence in favour of recent change on the lunar surface is, however, somewhat diminished when we find that Lohrman has inserted a minute crater on the convexity in his map, made from observations taken between 1822 and 1836.

W. Lassell, Esq., has figured and described an unusually irregular outline of the moon's limb, as seen with his 9·1 inch reflecting equatorial, at Malta, where it is at present mounted. A mere description will hardly convey an idea of the irregularity; but the drawing given in the monthly notices of the Royal Astronomical Society, shows sharp peaks of mountains and deep valleys interfering with the regular outline of the moon, whilst one portion, extending over more than 11 degrees of latitude, is quite flat, if not really concave. Mr. Lassell, in conjunction with his talented assistant, Mr. Marth, has also sent to the Society several measures of the small star, in the neighbourhood of *Procyon*, both in position and distance. They scarcely tend to establish the hypothesis of any physical connection with the large star. They have also sent the results of a series of observations of *Uranus* and *Neptune*, made during the splendid, and, as it now appears, exceptional season of 1852. They are at present much occupied with *Saturn*, in observing, amongst other phenomena, conjunctions of the satellites (especially the closer ones) with the pole of *Saturn*, or with tangents to the limbs or ansæ of the ring, with a view to contribute towards a more perfect knowledge of the forms of their orbits. Mr. Lassell has likewise made a good many drawings of planetary and other nebulæ; but has not yet decided about publishing them. An engraving from a drawing of the large nebula, *Messier* 20, will be given in the volume of 'Memoirs of the Royal Astronomical Society.' It is the work of an Italian artist, and is in the main very correct, though the shading-off of the nebula is somewhat too abrupt, and the proportional magnitudes of the stars are not perfectly preserved.

A contribution to our knowledge of the astronomy of the ancient Egyptians has been sent to the Society by Mr. Bonomi. He has given a drawing from a diagram, engraved on the wall of the Belzoni Sarcophagus, which was made to contain the body of a king of Egypt 1,250 years before our era. In the upper part of the diagram is a figure of Osiris, curled up in the attitude of a tumbler, to represent the earth floating on the surface of the great ocean, which is here signified by zigzag lines that surround him. This idea of the earth floating on a vast expanse of water was entertained by all the nations of antiquity, and there is frequent allusion to this idea in the sacred writings. A little figure, standing on the head of Osiris, is the god-

dess of heaven, Neptè, supporting the sun, which is connected by the Scarabæus with certain divinities in a boat, held in the outstretched arms of a figure, supposed to represent the ocean. That part of the picture relates to some Egyptian dogma respecting the soul, which has not yet received a satisfactory explanation.

In a letter from Mr. A. Herschel, detailing some account of the observations of Professor Hees, of Münster, 'On the Radiant Points of Shooting Stars,' we find the following important points established. 1. The interval of a quarter of a century may produce *no sensible alteration in the direction of a meteoric stream;* and 2. Two meteoric streams may arrive at the earth at an interval of not more than ten days apart, *almost exactly transverse to one another in direction.* These facts are exceedingly difficult to explain upon general grounds; they are both, however, perfectly conformable to the hypothesis that shooting stars are cosmical bodies revolving round the sun.

Lieutenant-Colonel Strange has described a zenith sector, for the use of the Great Trigonometrical Survey of India. Owing to the grave imperfections of the old form of zenith sector, the Astronomer-Royal designed, and had executed, a new instrument for the Ordnance Survey. This instrument is one of the most original ever devised, and the work executed with it is of a very high order, but owing to its massive construction and great weight, being altogether 1,140 lbs., it is evidently unsuited for crossing the higher Himalayan ranges. The weight of Airy's Zenith Sector is chiefly due to the manner in which the azimuthal motion is obtained, namely, round two points external to the telescope and sector. The abandonment of this primary feature involved the abandonment of the whole design; and the subject had to be taken up *de novo.* Mr. Airy's fundamental principles being, however, preserved as a basis. A brief account of the new instrument is given by Lieutenant-Colonel Strange, in the monthly notices of the Astronomical Society, No. 9, to which we must refer those of our readers who wish to pursue the inquiry further. The work is being executed by Messrs. Troughton and Sims, and it is expected that it will not weigh more than 600 lbs.

A notice of Dr. Steinheil's stellar spectroscope has been given by W. G. Lettsom, Esq. With this instrument the colours of the stellar spectra are as distinctly pronounced as when one examines the light of the sun by means of a prism. The spectra of the larger stars are displayed with such brightness when the spectroscope is used with a nine-inch refractor, that there is hardly any doubt that it would give very satisfactory results with stars up to the second magnitude, when applied to instruments of not more than four inches aperture.

An elaborate paper has been communicated to the Society by Lieutenant-Colonel J. T. Walker, R.E., on the method of determining heights in the trigonometrical survey of India. The difficulties which beset observations of vertical angles in the plains of India are so great, and the inaccuracies to which they are liable, so serious that the observations taken before the year 1856 by the method of reciprocal vertical angles were a cause of much anxiety and uncertainty, because if erroneous, the lengths of the base lines and all operations emanating therefrom

would be erroneous. It was consequently determined to undertake a series of spirit levellings to fix the heights of the base lines, and verify a certain number of principal stations, more particularly those situated in the plains previously referred to. The main lines of levels were executed by at least two persons, each furnished with a standard level and pair of staves, one following the other, station by station, at a few minutes' interval. The various sources of error, and the precautions taken in order, as far as possible, to remove them, are detailed and discussed. It is stated that a comparison between the results of the spirit-levelling operations and those obtained from the principal triangulation, is found to be highly satisfactory in all instances where the vertical angles were measured at the time of minimum refraction, even where the triangulations had been carried for long distances over the plains already noticed. The average difference obtained at the end of four circuits, averaging 550 miles in length is 3·06 feet, and the maximum difference at any station is 8·7 feet, which occurs at a station in the valley of the Indus, 200 miles from the nearest hill station. In combining the trigonometrical with the levelled values, the latter are assumed to be correct and final; and stations obtained by the former process alone are referred to the nearest station of the line of levels.

Sir John Herschel has proposed to the President of the Society that an eyepiece for viewing the sun should be constructed, in which the eye would be defended by a revolving metal plate, having in it two very narrow slits diametrically opposite, each occupying a sector of the disc, say half a degree. The diaphragm being made to revolve five times in a second, a glimpse would be caught at intervals of one-tenth of a second which suffices for continuous vision. But the quantity of light which would enter the eye would be only 1-360th part of the total light of the sun. If the disc were an annulus of ten inches diameter, and the slits, four in number, were each 1-100th of an inch in breadth, the annulus revolving once in 2-5ths of a second, the quantity of light would be reduced to 1-785th part; and if the surface of the annulus next the sun were of polished metal or looking glass, the annulus itself would not become very hot. The annulus and the apparatus setting it in motion might be disconnected with the telescope, so as not to communicate tremors.

III. BOTANY; INCLUDING VEGETABLE PHYSIOLOGY AND MICROSCOPIC BOTANY.

Tetrapanax papyriferum, the rice paper plant, appears to suit the climate of New South Wales. M. Swinhoe gives an account of it in the 'Pharmaceutical Journal,' and describes the process of the preparation of the paper as follows:—

The cellular tissue or pith attains its full size the first year. The trunks and branches are mostly procured from the aborigines of the inner mountains, in barter for Chinese produce; they are rarely

straight throughout their length, and are usually cut into pieces of about nine inches long, and with a straight stick inserted at one end and hammered on the ground, the pith is forced out with a jerk at the other end. The pith is then inserted into straight, hollow bamboos, where it swells, and dries straight. If too short to form the required breadth of paper, several bits are inserted into a hollow bamboo, and, by rods inserted at both open ends of the bamboo, pressed together until dry. By this process, the short bits are forced to adhere together and form one long straight piece of the required length. Thus paper of almost any size can be procured. The knife used in paring the pith into paper is in shape not unlike a butcher's chopper. It is well sharpened on a stone, and when not used, kept with the edge in a wooden groove, held firm to it by two strings round the wood and the knife. Before using it, the edge receives a fresh touch up on a small block of wood, usually a piece of the timber of *Machilus ramosa*, shaped like a large hone. The block on which the pith is cut consists of a smooth brick or burnt clay tile, with a narrow piece of brass on a rim of paper pasted at each edge, on which the knife is laid, and is consequently a little raised above the bare tile itself. The block is laid flat on a table, and the dried pith rolled on it with the fingers of the left hand, and then the knife laid on the brass rims with its edge towards the pith, its handle being held by the right hand. As the knife is advanced leftwards by the right hand, the pith is rolled in the same direction, but more slowly, by the fingers of the left. The paring thus goes on continuously, until the inner pith, about a quarter of an inch in diameter, is left, resembling somewhat the vertebral column of a very small shark, and breaking into similar concave-sided joints. This is used by the Chinese as an aperient medicine. The paring produces a smooth continuous scroll about 4 feet long, the first 6 inches of which are transversely grooved and cut off as useless. The rest shows a fine white sheet. The sheets as they are cut are placed one upon another and pressed for some time, and then cut into squares of the required size. The small squares made at Formosa are usually dyed different colours, and manufactured into artificial flowers for the adornment of the hair of the native ladies, and very excellent imitations of flowers they make. The sheets most usually offered for sale, plain and undyed, are about 3¼ inches square, and are sold in packets of 100 each, at rather less than one penny a packet, or a bundle of five packets for fourpence. The larger-sized paper is made to order, and is usually exported to Canton, whence the grotesque but richly-tinted rice paper paintings have long attracted the curiosity of Europeans.

Dr. Hepp describes a new genus of Lichen, under the name of *Guepinia*, after Professor Guepin, of Anjou, who first found it. *Guepinia polyspora* of Hepp is the Endocarpon Guepini of Mongeot. It was collected on Gneiss rocks near Meran, in Switzerland, in November, 1863, by Dr. Milde. Under the microscope, Guepinia shows characteristic spores, which exist to the number of 100 in one ascus, whilst Endocarpon (a genus to which Fries, Rabinhost, Schærer, and

Nylander have erroneously referred the plant) contains only eight spores in each ascus.

Dr. von Fritich, of Zurich, enumerates the following species of Lichens, as found by him on Teneriffe:—Lecanora flava var. oxytona; L. liparia, Ach.; L. orcina, Ach.; Parmelia elegans var. tenuis; P. dendritica, Pers.; P. parietina var ectanea, Ach.; P. caperata, Ach.; P. cæsia, Hoffm.; P. speciosa, Wulf.; Gyrophora vellea, var. spadochroa, Ach.; Lecidea geographica var. atrovirens; Cladonia furcata var. rangiformis.

Professor Koernicke, of Welden, near Konigsberg, describes a species of Melampsora which does great injury as a parasite to fields of flax in Prussia. Urocystis occulta is another parasite which destroys the rye in Prussia.

The vegetable nature of Diatoms has been inferred in part from their mode of reproduction, *viz.* by conjugation, as in Algæ. Of late the process has been actually observed in Navicula serians, N. rhomoides, and Pinnularia gibba.

In leaf venation we usually find that the lateral veins in lobed or toothed leaves are placed in the centre of the lobes, and correspond to the extremities of the teeth. In some cases, however, the secondary veins correspond to the sinuses of the leaf, as in Coldenia procumbens, Cratægus Oxyacantha, and Rhinanthus. Alphonse de Candolle also found the same to be the case in several species of *Fagus* (beech) as in Fagus Gunnii, Hook, and F. antarctica, Fost. Species, however, which are nearly allied, sometimes present different kinds of venation. In some species the same leaf shows this phenomenon,—some of the veins going to the teeth, others to the sinus. This is seen in Fagus alpina, Poepp. and Endl., and even sometimes in the common beech (*F. sylvatica*), and F. procera, Poepp. and Endl. This direction of the venation furnishes characters for distinguishing the Fagus Sieboldii of Japan and the Fagus ferruginea (*F. sylvestris, Mirb.*) from the Fagus sylvatica of the Northern European continent. In the beech of the United States, as well as that of Japan, all the lateral ribs and veins distinctly run in straight lines to the extremities of the teeth, which are always distinct and pronounced. In the European beech, not only are the teeth less distinct, and pass often into simple undulations, but the ribs are directed rather towards the sinuses, or, at least, are curved near the teeth, except those at the summit of the leaf. Other species having lateral veins directed to the dentations are Fagus obliqua, Mirb. F. Dombeyi, Mirb. F. fusca Hook, and F. Cunninghamii Hook. Palæontologists should beware of laying too much stress on the venation as indicating genera in fossil plants.

In the species of Sonchus, Professor Wolfgang, of Frauenfeld, finds that the pappus is formed of three or four rows of cellules, the oldest part of the hairs being their extremity. The very fine pappus of Sonchus under the microscope presents at its point asy stem of small hooks, formed usually of five or six cellules disposed in eight lines, recurved externally in the form of a hatchet. This may be a useful

character in distinguishing the species. He thinks that the pappus may thus furnish distinctive marks in the case of Sonchus arvensis, arboreus, asper, oleraceus, palustris, and tenerrimus. All these species, and especially the last two, show best this system of recurved teeth, whilst the pappus of Sonchus divaricatus is markedly different, and approaches near to the species S. Rabdotheca.

A recent monstrosity observed in *Anagallis arvensis* seems to show distinctly a placenta formed from the axis, and the outer integument of the ovule formed from a leaf. The axile bud was formed from the sepals and petals, as well as from the leaflets forming the ovary. The specimens showed very completely the foliaceous nature of the organs.

Professor Cramer, from numerous researches into monstrous ovules and into the development of normal ovules, maintains that those of *Primulaceæ*, *Compositæ*, &c., are metamorphosed leaves, and those of *Leguminosæ*, *Umbelliferæ*, *Ranunculaceæ*, &c., are metamorphosed parts of leaves.

The normal tetracarpellary condition of the siliqua in *Cruciferæ* has been recently advocated. Four carpels are actually found in *Tetrapoma pyriforme*. The normal number of stamens has been considered eight or sixteen—the latter number occurring in *Megacarpæa polyandra*.

Dr. Alexander Dickson has given the results of his investigations on Malope and Kitaibelia. He finds that the development of the androecium, as regards the evolution of the staminal lobes, is essentially the same in both genera. The androecium at first appears in both as an even rim-like cushion, pentagonal externally, surrounding the flattened termination of the floral axis, which appears as a pentagonal depression. The external angles of the staminal cushion in both genera alternate with the sepals. The essential difference between the arrangements in the two genera consists in this—that in Malope, the five angles of the central depression are superposed to the external angles of the cushion; that is to say, the sides of the depression are parallel to the outer sides of the staminal cushion; while in Kitaibelia, on the other hand, the angles of the central depression alternate with the external angles of the cushion, the sides of the depression thus lying crosswise to the outer sides of the cushion. This is seen long before there is any appearance of the carpels. In both genera five pairs of lobes alternate with the sepals, and extending longitudinally in a radial direction are developed on the surface of the cushion, which, as development advances, grows up as the staminal tube. In the subsequent stages, the author fully confirmed the statements of Payer as to the development of the stamens. On each of the lobes a longitudinal series of mammillæ appears in a centrifugal succession, and from above downwards. Later, each of these mammillæ branches into two lobes, each of which is developed into a stamen, with an ultimately one-celled anther; so that at last there are twenty rows of stamens, or, perhaps, more correctly, two rows of bifid ones. The carpellary groups form the sides of a pentagon, which in each genus corresponds to the sides of the original central

pentagonal depression or cavity of the staminal tube. Thus, these groups are oppositisepalous in Malope, and oppositipetalous in Kitaibelia. Payer had observed the difference in this respect between the two genera, but has in his 'Organogenie' inverted the statement of the facts, and, unfortunately, at some detail (pp. 34, 5). The development of five pairs, alternate with the sepals, of longitudinal series of mammillæ, and the subsequent development of each mammilla into two stamens, so exactly corresponds with what Payer has shown of the development of the stamens of Malvaviscus—where he has shown, besides, that the staminal tube is formed by the coalescence of five originally distinct staminal bosses or cushions superposed to the petals, similar to those in the majority of polyadelphous plants—that there can be no doubt that in *Malope* and *Kitaibelia*, as well as probably in all the other *Malvaceæ*, the androecium consists essentially of five compound stamens superposed to the petals. The difference in the development of the inside of the staminal cushion depends not on any difference in the position of the compound stamens, but probably on the constitution of the central depression—that is, of the termination of the floral axis; for it is easy to understand that the cells from which the carpellary groups are to be developed may be capable of conditioning the form of the cavity of the staminal cushion in accordance with the position of these groups. Such considerations, of course, do not at all go to explain why the carpellary groups should be differently placed in the two genera. An equally remarkable and somewhat analogous case occurs in *Tiliaceæ*, where Payer has shown that the staminal groups are oppositipetalous in Tilia, and oppositisepalous in Sparrmannia.

Professor Heer has examined the plants found under the ancient lacustrine habitations in Switzerland, more especially those discovered at Robenhausen and on the Lake of Pfæfikon. The vegetable remains are almost all carbonized. At Robenhausen, Wangen, Lake Constance, Moosedorf, in the centre of Berne, the Isle of St. Pierre, and other localities he finds among cultivated plants Triticum vulgare, L., two varieties, T. turgidum, L., T. monoicum, L., T. dioicum, L., T. Spelta, Hordeum hexastichum, L., H. distichum, L., Avena sativa, L., Secale cereale, L. The culture of the last (common rye) appears much later in history than that of the other cereals. Setaria italica is also found, which, according to Cæsar, was the principal cereal of the ancient Helvetians. In the more recent habitations three Leguminous plants are found—the common bean, the common pea, and the lentil. Among the fruits found are apples, and the drupes of Prunus insititia, P. Padus, and P. spinosa. A species of flax allied to Linum perenne is also found. Among the remains of wild plants are the raspberry, strawberry, elder, water chestnut (Trapa natans), hazel, beech, Silene, Papaver Rhœas, juniper, Scotch fir, spruce, yew. Also seeds of aquatic plants, such as Scirpus lacustris, Ceratophyllum demersum, Potamogeton, Polygonum Hydropiper, Galium, Pedicularis, Menyanthes, Nymphæa alba, Nuphar luteum, and N. pumilum.

From careful examination of two fossil cones of Lepidodendron,

Professor Schimper considers the plant more nearly allied to Selaginella than to Lycopodium. A specimen of Lepidodendron fruit was purchased about fifteen years ago by a physician of Lower Alsace, from an antiquary in Paris, who did not know the locality whence it had been taken. The upper half of the specimen belonged to Robert Brown (*Botanicorum facile princeps*), who bought it for about 700 francs, whilst the lower half came into the possession of Professor Schimper. Another equally good specimen has been recently found in a valley of the Pyrenees, near to Barèges.

IV. CHEMISTRY.

(*Including the Proceedings of the Chemical Society.*)

First among the additions which have been made to our knowledge of Chemistry since the date of our last 'Chronicle,' we must notice Mr. Graham's continuation of his experiments with Silicic acid and other colloid substances.*

It is impossible to condense into a short space this highly important paper, in which a series of most interesting facts, arrived at by a long course of investigation, are expressed in the fewest possible words. We have no option but to refer the chemical reader to the original, which will be found in the Journals indicated below.

A good deal has at different times been written about a *passive state* of metals, or a condition in which they are insensible to chemical agents; and a day has been looked forward to when iron would never rust, and silver never tarnish. That day now appears more distant than ever, for Dr. Heldt has shown that the facts on which this hope was based admit of a very simple explanation. The author shows that by certain agents the surfaces of metals become coated with an insoluble compound which prevents further action. But other agents remove this covering, and the action again proceeds.†

The preservation of iron ships is a subject to which we have before alluded, when speaking of the patent of Messrs. Johnson and Calvert.‡ The subject has recently been investigated by M. Becquerel,§ who finds that it is not necessary to cover the iron plates entirely with zinc, but that bands of this metal placed at intervals around the ship suffice to protect the iron from oxidation.

We may refer, in passing, to the discussion of a question of great industrial importance which has lately engaged the attention of the French Academy of Sciences.‖ It is the question, By what agency is iron converted into steel? M. Margueritte contends and quotes ex-

* 'Proceedings of Royal Society,' vol. xiii., with additions in 'Chemical News,' vol. x. pp. 97–109.

† 'Les Mondes,' t. vi. p. 413.

‡ 'Quarterly Journal of Science,' vol. i. p. 119.

§ 'Comptes Rendus,' Oct. 31, 1864.

‖ 'Comptes Rendus,' t. lix. pp. 185–376 et seq.

periments to prove that it is by the agency of carbon alone. Iron, he tells us, exposed at a red heat to an atmosphere of carbonic oxide (the presence of nitrogen being carefully excluded), assimilates carbon, is converted into steel, and carbonic acid is formed. M. Caron, on the contrary, without denying that carbon may have some influence on the result, contends that the presence of nitrogen is absolutely indispensable, and affirms that cyanogen is a true agent in the conversion. A paper, which we shall have to notice in the Proceedings of the Chemical Society, throws some light on this question.

MM. Reich and Richter have now obtained a sufficient quantity of their new metal, Indium, to enable them to determine its atomic weight and principal chemical properties. The former must be regarded as merely approximative, for the methods employed were such as could hardly lead to conclusive and accurate results. Of three not very closely concordant determinations, the authors prefer that which gave the number 463·4 O = 100, which corresponds to 74·14 O = 16. Indium is a white metal, very soft and ductile, and which does not easily tarnish. Its specific gravity is 7·277 at 20·4° C; and its fusing point is about the same as that of lead. It is easily soluble in acids. Sulphuretted hydrogen does not precipitate the sulphide from acid solutions (except acetic): ammonia throws down from them the hydrated oxide. Carbonate of soda throws down a granular carbonate. The most characteristic tests for Indium are the spectrum experiment, and the blue colour which the chloride and sulphide easily communicate to the flame of a Bunsen's burner.*

Speaking of metals we may mention a process for covering metals with bright layers of each other, which has recently been devised by M. Weil.† The author makes an alkaline solution of the metal to be deposited, and adds to this some organic matter, such as tartaric acid or glycerine. The metal to be coated is placed in this solution, and if necessary a weak voltaic current is set up by placing a piece of zinc in contact with the metal. Iron and steel can in this way be firmly coated with copper, beautifully varied effects of colour being produced according to the thickness of the layer of copper. Zinc, nickel, and silver, may also be deposited on other metals by the same process.

A new blasting powder has been introduced, which has been analyzed by Dr. H. Schwarz.‡ The percentage composition of the powder according to the analysis will be as follows: sulphur, 10 parts; charcoal, 15 parts; nitrate of potash, 56 parts; nitrate of soda, 18 parts. The difference is made up of moisture. Such a composition will, of course, be cheaper than ordinary gunpowder.

In organic chemistry, the progress in which is perhaps more rapid than that made in any other branch of science, we have nothing to report which would interest the general reader.

* 'Journal für prakt. Chemie,' Bd. xcii. s. 480.
† 'Comptes Rendus,' Nov. 7, 1864.
‡ 'Bulletin de la Societé Chemique de Paris,' t. ii. p. 391

Proceedings of the Chemical Society.

The first paper read this session was by Professor Wanklyn, "On Valeryl, the Radical of Valerianic Acid." This paper disclosed a very unexpected reaction. When Valerianic Acid is acted upon by sodium, the author found that ethylate of sodium and valeryl are produced. A similar separation of the acid-forming radical in other ethers induces the author to believe that the acid-forming radical is the base in some ethers, and that it would be more correct to describe valerianic ether as ethylate of valeryl, than as valerate of ethyl, and acetic ether as ethylate of acetyl instead of acetate of ethyl. In a subsequent paper, read November 17th, the author returned to this subject, and developed his views on the "Nature of Compound Ethers." He divides these bodies into three classes—*viz.* (1) Those in which the acid-forming radical is replaceable, as in the cases mentioned above; (2) those in which the alcohol radical is replaceable, and which he regards as true salts of the alcohol radical, such as iodides, bromides, chlorides, &c., of ethyl, and the rest; and (3) such bodies as common ether, the anhydrides, &c., in which the radicals are equally replaceable.

A very important paper, bearing on the Constitution of Steel, was read at the meeting on November 3rd. It was entitled "On the Existence of Nitrogen in Steel," and detailed the results of a large number of experiments made by Messrs. W. Baker and Graham Stuart. We may say, shortly, that the authors experimented with the best varieties of Sheffield steel, with Bessemer's, and with the celebrated *Spiegeleisen*. The results of the investigations, most carefully conducted, show that nitrogen is not an essential constituent of steel. It was found to be present in a few specimens, but the quantity was too minute to have any appreciable influence on the quality of the steel.

Another paper, by Mr. W. Baker, was read at this meeting, "On the Occurrence of Nickel in Lead, and its Concentration by Pattinson's Process." The author finds that nickel is commonly present in English lead, and that a considerable proportion may be removed by Pattinson's process. Thus, 5 tons of lead, containing 2 oz. 4 dwts. 11 grs. per ton of nickel, were submitted to the process. Four tons and a half were removed as crystals, and this lead, on analysis, showed the presence of only 1 oz. 10 dwts. 1 gr. of nickel per ton. Copper may also be separated from lead by the same process, but the quantity at starting must not exceed 10 oz. per ton.

At the same meeting, Professor Church read a paper "On the Blue Colour of Forest Marble;" and another "On the Effects of Ignition on Garnets," &c. With regard to the former: a block of Forest Marble is of a fawn colour externally, while the interior is of a bluish-grey colour. This has been ascribed to the presence of iron in the form of peroxide without, and protoxide within. Professor Church, however, showed that the blue colour of the interior is due to the presence of bisulphide of iron, which on the exterior becomes converted into sulphate of iron, and this by reacting on the carbonate of lime in the presence of air, forms sulphate of lime and hydrated peroxide of iron.

As regards the effects of ignition on garnets, &c., Dr. Phipson has

asserted that these stones undergo expansion at a red heat, but gradually return to their normal dimensions; and after a considerable interval of time assume their original specific gravity. This statement Professor Church cannot confirm. He found, in fact, that many stones of the family did undergo expansion when exposed to a heat sufficiently strong to fuse them, but that they remained permanently reduced in density in consequence. At a red heat he found them all practically unaffected. The Professor returned to the subject at the meeting on December 1st, and confirmed the results he had previously announced.

Another valuable practical paper was read on November 17th, by Dr. Marcet. The subject was the "Brine of Salted Meat." The practical object of this paper was to show how large a quantity of nutritive matter was wasted in the brine, and again when the salted meat was soaked in water to prepare it for cooking. In both cases the waste was easily avoided. To recover the nutritive matter from the brine the author evaporates the latter at a moderate temperature to one-third its bulk, decants the liquor from the salt deposited, and then removes the remainder of the salt by dialyzation. In this way he obtained a liquid which made a good and cheap soup. To prevent waste in salting, the author proposes to cut the meat into small pieces and place it with ten or twenty per cent. of salt, in sausage skin or bladders, and then to immerse these in a strong brine, and there leave them until the meat is sufficiently impregnated. The skin, we ought to say, must be quite full. When the meat is required for use, the skins have only to be placed in fresh water for the salt to dialyze out. The author pointed out that joints salted in the ordinary way might be made to retain much nutritive matter if they were closely wrapped in skin or bladder before they were soaked. A practical point of less general importance was a suggestion by Dr. Marcet, that brine might be used as a source of inkreat, kreatinin and lactic acid.

V. ETHNOLOGY.

(Including the Proceedings of the Ethnological Society.)

A CHRONICLE of the progress of Ethnology is not the easiest thing to write, for the simple reason that it is very doubtful how and when progress is really made. It is perfectly true that we have many indefatigable skull-measurers, voluminous writers, readers of papers, and pamphleteers, both unitistic and pluralistic, or, if it be preferred, monogenistic and polygenistic; but, as yet, there is for Ethnology neither any such absolute definition of terms, nor any such agreement as to bases of arrangement and classification as characterize every other established science. What is considered right to-day, is too often considered wrong on the morrow, and even its very name is a subject of dispute, and strenuous efforts are being made to merge the long familiar cognomen of the "Science of Races" into the more modern and less euphonious designation compounded by those who

assert it properly to be the *de facto* science of men and monkeys. Perhaps there is not much in a name, and if there were anything better done in Anthropology than in Ethnology, we might not feel disposed to quibble more about the one than the other, any more than we should over Geognosy and Geology. It is not, however, certain whether we ought to regard the study which Ethnology pursues as *the* "Science of *Man;*" it is much to be questioned whether we should not begin at least with the "study of *Races*," for whether all mankind came from a single source, or from a plurality of origins, it is equally a fact, equally certain, that numerous *races* of men *do* exist. If then, we can classify, and describe under an accurate system of terms those races which *do exist*, there will have been established the rudiments of a proper science, which can be expanded and elaborated in all directions. But whilst one person describes a Celt as having a round head, or brachycephalic skull, and another insists that his head was long and his skull dolichocephalic, it would be idle to contend that even the proper foundations of the Science have as yet been clearly established. Nor is Anthropology in any better position. All that has been done under either name—valuable though much of it be—has been in a high degree erratic and unsatisfactory. Nor, in saying this, would we in any way detract from the valuable labours of Blumenbach, Pritchard, Latham, Knox, Nott, and Gliddon, Crawfurd, Broca, and many others, living and dead, not the least of whom, and, to the mind of the writer, the most philosophical of all, is Georges Pouchet, whose concise and logical work 'Sur la Pluralité des Races Humaines,' deserves to be everywhere read, albeit that it is violently opposed to the ordinary faith in the unity of mankind. Of this remarkable book a second edition was recently published, and was almost immediately followed by a translation under the direction of the Anthropological Society of London, but which, to the regret of every one, has proved so full of errors, both of translation and in the rendering of the author's meaning, as to have been universally condemned by the critics of the periodical press. Perhaps it is this fear of admitting a plurality of origins for the varieties of mankind that has been the greatest cause of obstruction to the progress of Ethnology as a science; certainly the hard tuggings in opposite directions by the monogenists and polygenists have been the primary source of all the confusions and contradictions with which both Ethnology and Anthropology abound. Both views should be candidly and fairly discussed, unbiassed by any religious faith or any theological considerations. The chemist does not work in his laboratory Bible in hand, why then should the Ethnologist any more than the Geologist be restricted to seeing everything through the first chapter of Genesis? If all human beings, black, red, and white, be the children of one primitive Adam, let us philosophically prove it by the inherent force of truth elicited from facts by logical deductions. If the various races come from different origins, and bear, like species of plants and animals, the impress of different natures and adaptations for different uses, then let it be so admitted frankly and fearlessly, when facts and proper arguments have *positively* proved it.

So far the papers discussed during the present session before the Ethnological Society of London have been mostly papers previously read at the Bath Meeting of the British Association, and have contained neither novel nor very important matter. The most suggestive paper has undoubtedly been one of Mr. Prideaux, "On the Principles of Ethnology," in which he pointedly draws attention to the unsatisfactory condition of terms and first principles, and does not shrink from declaring that even "the foundation-stone of a durable and scientific edifice has yet to be laid." Nor does he leave the subject as Ethnological subjects are too often left, with laments only of the want of something better, but he shows—if not a certain remedy—at least how an amelioration of matters may be begun in a proposed *decisive attention* to the characteristics of *existing races*.

Just as geologists, by studying existing phenomena and living creatures, have interpreted the phenomena of past ages and past creations of organized beings, so he would have the foundations of the interpretation of mankind's past history and development rooted in the phenomena of the living human beings swarming over every part of our sunlit globe, and contemporaries of ourselves. Amidst all the amalgamation of races, he argues, that have taken place, nothing is more certain than that *types of great antiquity* are always present, and in great numbers and very tolerable purity, amongst our populations. No indiscriminate blending of blood takes place, producing an homogeneous offspring according to the numerical proportions, or the relative vital force of the component races, and thus extinguishing the recurrence of the original types. But on the other hand we cannot take upon ourselves to say that this can never be effected in a long period of time in a mixed race, subjected to the same climatic conditions. The first task to be undertaken, in order to conquer a solid basis for the science, is the recognition and identification of existing types by which we are surrounded. This accomplished, the study of the phenomena, presented by living contemporaneous populations, follows next. What changes are being effected? what evolutions are in progress? what laws have governed the production of the type-forms recognized amongst them? In the answers to these questions will most probably be found the key to the history and transmutations of the past.

Another paper deserves also some special mention. Dr. Shortt's "account of some rude tribes, supposed to be Aborigines of Southern India." Such accounts given in anything like an intelligible form, are always interesting, especially when habits, legends, and personal incidents are graphically detailed; but when features, weight, stature, and measurements are recorded with precision, the data become valuable additions to the general stock of useable and comparable information.

In these latter particulars, Dr. Shortt always exhibits such praiseworthy order and care, as to make us always feel certain of his facts, although we may sometimes feel doubtful of his comparisons, as, for example, his association of the Yenadis, and other rude tribes of Southern India, with the Mongolian type. Of the several tribes noticed by him in this paper, the most interesting are the Iroolers of

the vicinity of the Ramagherry Hills, and who may really be a descendant remnant of the Aboriginal inhabitants of India, before it was overrun by the present dominant Hindu race. But the Iroolers even here exist no longer in untainted purity of manner. Brahminism has tinged their religious feelings, and Nagalapooram, the village in which they chiefly reside, is celebrated for its temple and dancing girls. The annual *Sootia Poojah*, or worship of the sun, is there celebrated with considerable pomp; and anxiously do the deluded people watch the rays of the sun enter the temple and glow on the uncouth features of the senseless log-god in its midst. Great is their joy, and happy the omen; the worshippers being too ignorant to understand that through a loop-hole cunningly constructed the sunbeams enter on this one day of the year, and attributing to their insentient idol the working of so wonderful a miracle.

In his paper "On the Fixity of Type," the Rev. Mr. Farrar argued that from the dawn of history to the present time, an extraordinary fixity of type had characterized all the recorded races and varieties of mankind, and which was not accountable for by the effects of climate, custom, or food. He did not, however, touch, in anything like a scientific manner, the great point of *how* diversity of race has been produced—for assuredly climate, food, and other circumstantial conditions must be admitted to have operated, if the theory of the unity of mankind is to be maintained. It is useless to adopt Mr. Reginald Poole's clever argument with respect to the Egyptians for a wider range, and to urge that as since the dawn of the historic period to the present time, no symptoms of any change of type in the same race, however slight, can be detected, therefore no change had ever previously occurred, without giving in an adhesion to the doctrine of a multiplicity of race-origins. Nor, perhaps, can this line of argument be unanswerably urged, for just as, notwithstanding between the extremes of the earth's wide orbit although we can get no parallax for a distant twinkling star our senses assigned to it a remote but definite distance, so the rays of the gradual change or modification of a human species may come from so remote an age as to appear to our limited investigations, strictly parallel and non-divergent. Suppose climate an effecting cause of modification, how few races or species are at at all affected by variations of one degree of temperature, and yet how long a period would the supposed secular cooling of our globe take to bring down the general temperature of the earth that one degree. A hundred thousand years? If so, and it would not be less, to get the influence of one degree of cooler climate upon a human species, —and how little that would be—it would take fifty times the whole historic period. How difficult, then, to determine what is fixity of type or what is slow but certain change.

VI. GEOGRAPHY.

(*Proceedings of the Royal Geographical Society.*)

THE regions of geographical discovery and survey of which we have received accounts during the last six months, have been comparatively few. Central Africa seems to monopolize almost all those enterprising discoverers, who are able to make a hobby of this science, to spend their season (of two or three years) in exploring, and to return to spend another season in book-writing and in lionizing in the drawing-rooms and discussion chambers of London. From somewhat farther afield came M. Vámbéry, the visitor of Samarcand; Mr. W. G. Palgrave, whose paper we epitomized in a former number; Viscount Milton from the Rocky Mountains, where he spent in toil months that might have been passed amid every luxury in England, and Mr. John Macdowall Stuart from Central and Northern Australia. We have besides this an account of the settlement of a new colony on Cape York, of the laying the electric cable in the Persian Gulf and Mesopotamia, with a description of the islands of Kishm and Ormuz, and of an attempt to carry a railway over the Serra do Mar in Brazil.

The discoveries in Central Africa have been diminished by the shocking and untimely death of Captain Speke in the midst of the ovation he so well deserved; by the decease, on their travels, of the Dutch ladies who had penetrated to the Soudan, but had been obliged to return; by the loss of Dr. Schubert, who was in search of Dr. Vogel, and by that of M. Jules Gérard. On the other hand, we now have in England Dr. Livingstone and Captain Burton, in addition to Dr. Kirk, Mr. Galton, and others, who were here before. By these, each new discovery is canvassed with minuteness that borders sometimes upon cavilling. Scientific researches require coolness and calm discussion, and mistakes may well be acknowledged with frankness or pointed out with gentleness. Captain Burton, formerly consul at Fernando Po (where he is to be succeeded by Mr. Charles Livingstone, brother of Dr. Livingstone), but lately promoted to a like post at Santos, in South America, is said to be about to employ the six months' leave of absence which he obtains on this promotion in the exploration of a certain portion of the continent which of late years he has penetrated. In the meantime he gives to the world two handsome volumes on his late expedition to the King of Dahome, undertaken with a view of diminishing, if not putting an entire stop to, the brutal so-called "Customs." Though unsuccessful in the main object of his mission, he has written a most interesting account of the manners and peculiarities of these barbarians. The Grand Customs and Yearly Customs were witnessed by Captain Burton, and the account of these and of the Amazonian army, naturally form the most interesting and original portions of his work. This army of Amazons is computed at 2,500, and is divided into razor women, elephant huntresses, bayonet women, blunderbuss women, archeresses, &c. They mostly have a great tendency to fatness, nevertheless they are

indefatigable dancers, and march with a most military swagger. The women are originally of a very masculine character, and the style of life they lead adds to this appearance. About a third have been originally married women, but have been presented to the king (whose wives the whole 2,500 are supposed to be), by their husbands whom they have maltreated or to whom they have been unfaithful. Notwithstanding the presumed marriage with the king, when the army was lately about to march against Abeokuta, about 150 of these *soldiers* who had no right to be so, were found to be pregnant. Under these circumstances, they have to undergo a form of trial with their paramours, when frequently the guilty parties suffer death. The present king, however, is somewhat more merciful than his predecessors, and his jealousy is appeased by some less grievous punishment.

Though not actually witnessing the execution of any human victims at the Customs, Captain Burton saw enough to convince him of the enormous amount of blood spilt on these occasions. The whole subject is a curious one, and those who wish thoroughly to understand the extraordinary nature and origin of these sacrifices, must study the volumes themselves: we can only give a brief outline of some of the performances. The original idea is that of filial piety. The deceased monarch requires to be accompanied to the land of shades by his principal and other eunuchs, by various wives and a variety of other attendants. Accordingly victims who would amount to a small army, and may amount to 500 in number, are despatched at the Grand Customs. But besides these, others are sacrificed every year. Under the present king these amount to about forty men, and as many others are murdered by the Amazons, so that nearly eighty persons besides the first fruits of prisoners of war and all criminals are butchered yearly by these savages to fulfil their notions of filial piety. On the "Evil Night," moreover, all who make their appearance out of doors, do so at the risk of their lives. The present king, Gelele, is rather more inclined to these sacrifices than his father Gezo, who had reduced them considerably. The Amazon army had been much diminished by the former attacks on Abeokuta, and had never entirely recovered its numbers. Still these female warriors were in high spirits with regard to the war which was just impending when Captain Burton was at Dahome. The *captainess* of the Beauty Company, in an address to the king shortly before the expedition, with much eloquence, if eloquence consists in action, declared, after she had cut off the head of an imaginary corpse, "Thus they would treat Abeokuta." But Abeokuta refused to be thus treated, and the Amazonian army was cut to pieces, and the king narrowly escaped with his life. It is not likely that this kingdom of Dahome will ever rise again to its pristine condition after this terrible blow.

The travels of Dr. Livingstone, as well as his later movements, we abstain from relating, since his work on this subject is promised early in the year. This will be accompanied by the narrative of Mr. Charles Livingstone's expedition to the Zambesi and Lake Nyassa. It is, however, not likely to pass without severe criticism, as almost every African explorer has his own opinion on the direction of every river,

and the boundaries of every lake, whilst one or two Englishmen seem inclined to back the explorations of the Portuguese in preference to that of their own countrymen. We must hope that this devoted traveller will profit by the remarks made on his former work, and will arrange his present production in a more logical manner, and take some pains about the actual composition, so as to give his work a more readable character than the former. One of Dr. Livingstone's former companions, Mr. Thos. Baines, the artist of the expedition in 1858, has now published an account of his journey from Walvisch Bay on the Western Coast to Lake Ngami, and thence to the Victoria Falls on the Zambesi, undertaken in the years 1861 and 1862. The route described is not one of any great interest, as it has almost entirely been traversed before, but the word-pictures of the artist make us hope that the actual sketches may some day find their way to the public eye. At the same time the work itself is somewhat tedious, arising from the fact that the author has been unable to act as editor, otherwise we may be sure that much which was interesting enough when first sent home, would have been cut out, and that repetition of similar every-day occurrences would not be chronicled with the fidelity of the writer of a Court Circular. Mr. Baines's collection of Natural History Specimens will no doubt add much to our present knowledge, at the same time his want of scientific nomenclature prevents many of his descriptions from being of such use as they otherwise might become.

Other travellers are pressing in upon this continent. M. du Chaillu, the report of whose death turns out to be untrue, is advancing towards the interior from the western side. The upsetting of a boat had caused the loss of his instruments, but these have been replaced. Though M. du Chaillu lives, Dr. Schubert of Leipsig, attached to the expedition in search of Dr. Vogel, and Madame Tinné and her maids, have forfeited their lives in the pursuit of science; Baron von Heuglin, however, continues the researches begun by her in spite of the obstacles thrown in his way by the slave merchants and other dealers, who are unwilling that too much light should be thrown upon their nefarious traffic. He has already discovered several isolated mountains, and one range to the west and north-west of the Quola country. He contributes various ethnological, linguistic, and geological facts to the previous knowledge of the kingdom. It is sincerely to be hoped that the slave trade of the interior, which is really the greatest obstacle to research in these parts, should be checked by the official interference of European authorities —a measure much easier of execution and much more useful in its fulfilment than the watching an extensive coast for the departure of slaves. The recently-announced death of another brave adventurer, Jules Gérard, who attempted to penetrate into Central Africa, from the West Coast, is also to be sincerely regretted. Although completely unsuccessful in every attempt to enter the interior, and notwithstanding that his accounts of the places where he sojourned have been meagre, we think it right to refer with regret to his untimely end.

From Australia the news is but small. A new town has to be

added to our map, *Point Somerset* (named after the First Lord of the Admiralty), at the extreme north of Cape York, which is itself the northern portion of the continent. The new colony lies on a peninsula of the main land, immediately opposite Albany Island. It will form an important station for the mails from Melbourne, Sydney, and Brisbane, in their way northward, by way of Batavia, to meet the China mail. The whole of the northern portion of this peninsula promises to be fertile and salubrious to Europeans. The colony itself, which includes the whole of Cape York, has been chosen especially with a view to the health of the inhabitants and officials. It is open to the sea breezes, both from the Pacific and the Indian Oceans. Both round the coast, and across the country by the Flinders, and other streams, the settlements are creeping on to the Gulf of Carpentaria. The geology of the inland portion of the colony of Queensland deservedly attracts much attention amongst the colonists. Mr. Coxen has written a paper, read before the Philosophical Society in Brisbane, detailing the results of a very extensive and careful survey. The principal formations are primary or secondary, and those of most practical importance are either decomposed trap mixed with calcareous sand over shales, making a most fertile soil, or carboniferous strata, which latter are said to be very plentifully distributed.

Central Africa having been so frequently discussed, and the subject having received all the ventilation which it is possible to bring to bear upon a subject where the inductions must be from so few instances, it is refreshing to find oneself on new ground, and to traverse with M. Vámbéry the districts of Central Asia. Old as the subject is, it becomes new from its very antiquity. The last traveller who has left us Englishmen an account of much of the ground that this distinguished Hungarian has travelled over was Marco Paulo. Ruy Gonzales de Clavijo, Spanish Ambassador to the Court of Timour Khan, visited Samarcand in the zenith of its splendour, but at such personal inconvenience that his narrative can hardly be expected to give us a fair description of the place. Timour was so anxious to get the Spaniard to his palace in time for a particular festival, that the latter was compelled to travel at a pace which killed one of his companions, whilst he himself was worn out. On his arrival, he, the abstemious Spaniard who never touched wine, was compelled to be present at banquets from which but few guests departed sober. Nevertheless he describes the city as containing very fine buildings, besides many which, though not completed, gave great promise of splendour for the future. Very different is M. Vámbéry's account. His description has lately been published by Mr. Murray, previously to which the main outline was read in the form of a paper before the Society, and additions were made *vivâ voce* to the written document by the gentleman himself, who overcame, for the benefit of the meeting, his natural repugnance to speak a language he was far more accustomed to read than to hear or pronounce. His linguistic triumphs in Turkish, and Arabic, and other Oriental tongues, demanded and received some indulgence from an English audience.

The great desire of M. Arminius Vámbéry, like that of many of his countrymen, was to throw some light upon the linguistic connec-

tion of his native tongue. Thinking that the dialects of Central Asia would assist him in this scientific research, he settled for four years at Constantinople, studying as a Mollah or Divinity Student in the colleges there. Thence he passed into Asia, arrived at Teheran on the 13th of June, 1862, and at last, after nine months' sojourn there, joined a party of twenty-four dervishes who were returning from Mecca to their own country. This even was a matter of some difficulty, owing to his dress and colour. In the former matter he soon conformed himself to the habits of his companions, and became even the dirtiest of the fraternity. Thenceforth he journeyed onwards in the disguise of a Moslem pilgrim, or holy man, whose blessing was craved by, and for a consideration granted to, many a robber chieftain, and whom women of the greatest beauty, and girls even, desired to embrace. With a pilgrim's staff and a copy of the Koran he crossed the desert to Khiva. He stayed among the Turcomans a month, observing the extraordinary liberality and hospitality, combined with cruelty and tyranny, which make up their character. His visit to Khiva is not so interesting, since it is well known, from having been visited by Captain Abbott and Mr. Thompson. Continued suspicions pursued the unfortunate traveller on his road. He was constantly being taken for an English, Russian, or Persian spy. At Khiva, the Prime Minister had been at Constantinople, and consequently this great authority was easily persuaded that the traveller, who had acquired a surprising command of Arabic, and a thorough knowledge of the Mussulman ceremonial (which he exemplified by blessing the Geographical Society in true Oriental style), was really what he professed to be, a true Mollah from Constantinople, seeking the tomb of some holy man. From Khiva they journeyed to Bokhara, along the left bank of the Oxus. In order to escape a party of Turcomans coming to plunder them, they were obliged to flee into the desert called Djan-bateran (the destroyer of life), where they encountered horrible thirst, and from this cause lost two of their party. The description of the death of one of these men, and of the fear of a like fate that invaded M. Vámbéry, is worthy of the attention of sensation novelists, so horrible and so uncommon does it appear. In Bokhara our traveller encountered fresh danger from political espionage, but by a little tact and impudence he compelled the vizier to acknowledge him as a renowned dervish, holding out threats of eternal punishment if he suspected him. The reigning prince Moozaffar-ed-din, son of the murderer of Conolly and Stoddart, is described as a man of a pleasing countenance and good disposition, "but forced for political reasons to commit many tyrannical acts." After a month at Bokhara, just as he was departing, he was summoned to an interview with the monarch himself, with whom again a good share of audacity succeeded in procuring recognition and dismissal. Thence the journey to Samarcand was through a thickly-peopled and well-wooded country, abounding in villages and towns, but the capital itself was disappointing, not only for its present insignificance, but also for the few relics of its former reputed splendour. The Medresses or colleges were the most remarkable buildings, and one erected by the wife of Timour surpassed every other building

in magnificence. The palace and tomb of Timour must attract attention: his throne consisted of a block of greenstone which was brought from Broussah, but by what means it is difficult to imagine. In the burial-place of Tamerlane his first teacher is buried next to the conqueror, and around him his children, whilst beneath the minutest details are exactly copied. After ten days at Samarcand, M. Vámbéry proceeded to Karshi and thence to Herat. In this place, which is tolerably well known, he considered himself safe; still he was suspected, and had great difficulty in getting farther, but his journeying from this point was over known ground, and therefore it need not be further related.

The electric telegraph from India to Europe adds an interest to localities otherwise of but little importance. It is not improbable that it may be the means of opening up the navigation of the Euphrates, now for some years stopped. The Isles of Kishm and Ormuz, at the mouth of the Persian Gulf, were visited by Lieut.-Col. Lewis Pelly, Acting Political Agent in that neighbourhood, in December, 1863. The principal natural curiosities are naphtha springs and salt caves of a height and length of from 200 to 300 feet, with a span of 60 to 70 feet, in hills varying from 300 to 600 feet in height. The salt in the mass is beautifully streaked, whilst large crystals hang in festoons from the roof, and are of a snowy white. The salt is carried on the backs of asses and camels to the shore, whence it is exported to Calcutta and the east of Africa. The Isle of Ormuz, though said to be the site of a magnificent city, shows no remains that would indicate such a fact.

The Royal Geographical Society.

In opening the present session of the Geographical Society, the President, Sir Roderick Murchison, drew the attention of the Society to what they must expect to form the staple of their discussions during the ensuing months. Central Africa still affords the widest field for discovery: it moreover possesses many points of attraction to travellers, it is the nearest of unexplored lands, affords any amount of difficulty in travelling that suits the investigation, has enough of romance in it to dazzle the mind, and its configuration is a problem not to be solved by analogy, but at the same time throwing some light on the similar continent of Australia. In the loss of Speke, we mourn not only the man who has done much, but we regret one who was to have done much more, who, whilst Livingstone remained in England, might have carried on his investigations in Africa. An obelisk, similar to that erected to Lieutenant Bellot, is to commemorate his worth. The misfortune of his death was the only thing to mar the complete success of the geographical portion of the proceedings of the British Association. Amongst many excellent ideas struck out by that concourse of scientific minds, one very advantageous suggestion was made—*viz.* that the Government should be

requested to furnish the vessels of H. M. navy with the deep-sea sounding apparatus, such as was used under Sir L. McClintock, in the 'Bulldog,' and that the results of the researches that might be carried on, should be recorded in the Hydrographic Department of the Admiralty, and the specimens forwarded to the Geological Museum.

The first memoir of the session, "On the Head-waters of the Nile," by Captain Burton, is referred to below. The President alluded to the labours of Dr. Beke, Mr. Findlay, Mr. James Hogg, and Mr. Vaux, on various points connected with this interesting question. Mr. Consul Petherick had obtained news of Baker, who was said to have lately visited some great lake, probably Luta Nzigé; but further information was expected soon. The movements of Livingstone were next sketched, and the capabilities of Dr. Kirk rehearsed.

A letter from M. Du Chaillu, mentions that he was awaiting the arrival of new instruments, provided by the Society, to replace those lost by the upsetting of a canoe as he was disembarking in the Gaboon territory. In the meantime, he had made a collection of objects of Natural History, including several stuffed and one live gorilla, for the Zoological Society, which, however, has since died, besides upwards of 4,000 insects, including 500 butterflies. The notes of the late Richard Thornton, referring to the ascent of Kilimandjaro by Baron von der Decken, have been abridged by Mr. Bates to such a size, that they might be read before the Society. In the meantime, the Baron, who, it will be remembered, received the gold medal of the Society, is preparing to enter Africa by way of Zanzibar, when he received, through Sir H. Bulwer, Her Majesty's Ambassador at Constantinople, a firman which will facilitate his progress in the countries influenced by the Egyptian authorities. The President concluded by congratulating the Society on its prosperity, and the number of candidates for the fellowship.

A paper, by Captain R. F. Burton, in a tone, as was only seemly, of great moderation, combated the conclusion that the whole question of the sources of the Nile had been solved. Whilst acknowledging the many noble qualities of Captain Speke, he contended that the sheet of water known as Lake Victoria Nyanza, might, for all that was known to the contrary, consist of many smaller lakes; that the difference of level was irreconcilable with a connection with the Nile; whilst Lake Tanganyika might be 1,000 feet or more higher than the level assigned to it, inasmuch as the instrument by which it was measured was a common shilling thermometer, liable to be moved from its box-wood frame by the motion of a journey. Tanganyika then might flow into the Luta Nzigé, and thus become the head-water of a large branch of the Nile. The Mountains of the Moon, which were marked in Speke's map in 1859, did not exist, and were, in fact, originally an exaggeration of the engraver. The opinions of Captain Burton met with considerable support among the numerous African travellers who were present at the meeting, whilst a very general feeling seemed to exist in the meeting that much remained to be done in the way of elucidation of this vexed and important question.

XUM

Viscount Milton, accompanied by Dr. Cheadle, has been exploring the means of communication between Canada and the new colony of British Columbia. The results of these researches were laid in the form of a paper before the British Association, and have since been brought before the Royal Geographical Society. The party started from the Red River settlement westward, following in the main the direction of the Saskatchewan to Jasper House, then they traced the Athabasca and the valley of Myette, and across the watershed of the Rocky Mountains by the Leather Pass. The slopes were so gradual, that the travellers could scarcely imagine that they had crossed the ridge. They descended by the Fraser river to Tête Jaune's Cache. Here they met with great difficulty from the overflowing of the river—for days the water was up to the girths of their horses, or they had to climb the precipitous sides of the valley, where they could find no rest. They thence followed the track of some previous emigrants, crossed the Canoe river (a tributary of the Columbia), and then followed the Thompson, until the track they had been pursuing came to an end. Their predecessors had floated on rafts down the stream, thinking it hopeless to cut their way through the dense forests. These determined travellers, however, persevered. After a month, their provisions failed; they were reduced to pemmican and flour, and finally to dried horseflesh. At the end of three months from their setting out from Fort Edmonton, on the Saskatchewan, they arrived at Fort Kamloups, in British Columbia. The travellers consider that roads and even railroads might be carried over the district they traversed, and the advantages they sum up as follows:—(1) That this route runs well within the British possessions, and removed from the United States boundary; (2) that the Indians inhabiting the route are friendly; (3) that it is the most direct route between the gold regions of British Columbia and Canada; (4) that it is easier, and at a less incline, than any other within British dominion. The drawbacks are a want of pasturage for cattle, less open country than borders some of the more southerly passes, and an increased liability to be blocked by snow. A very large portion of the route is through forest, and some of this forest is also swamp. A road would have to be made; but it could be made without great difficulty. On the way, the country between the Red River settlement and the Rocky Mountains, is described as rich and fertile. These same Red River settlements are in a tolerably flourishing condition. The main difficulty is the want of provisions. The diggings afford good returns, but the digger must be a hunter too, and a want of a proper division of labour is felt. A great scarcity of water has been experienced, and hay has been brought from 10 to 60 miles for winter provision. The Sioux, to the number of 3,000, have at last been prevailed on to depart, much to the relief of the settlers from whom they begged their whole subsistence. The heat has been extraordinary, the thermometer having reached even 100° in the shade. The cattle have to frequent the river for drink, and even the bears do the like, appearing in the midst of the most inhabited parts, at a risk for which they pay dearly enough.

The last paper to which we can allude, was "On the New Country

of North Australia, discovered by Mr. John Macdowall Stuart." The country referred to, and which has up to this time gone simply by the name of Northern Australia, and in one part by that of Arnhem Land, has been called by Mr. Stuart, in his right as explorer and, in a sense, discoverer, Alexandra Land, in compliment to the Princess of Wales. The means of access to this district lie up the Adelaide river, which is a secure harbour at its mouth, and for 80 miles up has 40 feet of water. The land is rich and fertile, and is described as healthy for European settlers, provided Malay or Chinese workmen and labourers can be introduced in sufficient numbers to make cultivation profitable.

We would here draw the attention of discoverers to the importance of paying some attention to the nomenclature of new districts. Giving names from the members of the Royal Family, ministers, and the members of the exploring party, mark the dates of discoveries—thus Alexandra Land and Point Somerset mark the period of discovery and of settlement; but such a title as Adelaide river is apt to lead the student to the south rather than the north of Australia, whilst the scattering broadcast the name of one explorer over the whole continent, as that of some discoverers has been, is utterly bewildering, and makes the remembrance of localities, unknown to actual vision, a matter of impossibility. Thus we find in Southern Australia—Flinders county; to the north-west of this, Flinders Island; to the north-east, Flinders Lake; and again at some distance to the south-east, Flinders Black Rocks. In Queensland, we have a second Flinders County; to the south of which Flinders Peak; at some distance north again, Flinders passage; and again, to the north off Cape York (there is a Cape Yorke in South Australia), Flinders Island; and finally, an important, though yet untraced, river running into the gulf of Carpentaria, that is likely to become the means of communication between Brisbane and this northern settlement is called Flinders Creek. This is almost too much for human endurance, whatever may have been the merits of Mr. Flinders.

VII. GEOLOGY AND PALÆONTOLOGY.

(*Including the Proceedings of the Geological Society.*)

Of all systematists the Geologist is the most perplexed by the occurrence of "connecting links." In organic nature gaps seem to be the rule rather than the exception, while the intervals between rock-systems are often filled up by an insignificant series of strata, partaking of the characters of both the neighbouring formations. These connecting links, or "passage-beds," between groups of rocks, are, of course, fruitful sources of discussion, some Geologists taking the view that they belong to the overlying series, others the opposite; while others again, seeing that it is perfectly hopeless to expect that either one view or the other will ever be universally accepted, adopt a

middle course, and treat them as a "distinct formation." This last appears the wisest and most practicable course, although it is often objected to because the middle term, say the objectors, is not of the same value as those on each side; but inasmuch as the whole Geological series consists of a great many terms, and it is pretty certain that their values vary almost as much as in the case in question, this objection to a rational solution ought not to outweigh the advantages accruing from its adoption.

The above paragraph may be considered to represent the state of public Geological opinion, respecting the systematic position of certain strata, known as "the Passage-beds of the Lower Lias," the "Zone of *Avicula contorta*," the "Rhætic Beds," the "Kössen Beds," the "Gervillia-beds," the "Infra-lias" (pars), the "Täbingen Beds," &c., and recently called the "Penarth Beds" by the Geological Survey.

Lately several important memoirs have been published, in which this question has been discussed at great length; their titles and authors are as follows:—"Der Jura in Franken, Schwaben, und der Schweiz." By W. Waagen. Munich, 1864.

"Der Hannoversche Jura." By Karl Von Seebach. Berlin, 1864.

"Die Contorta-Zone (Zone der *Avicula contorta*, Portl.), ihre Verbreitung, und ihre organischen Einschlüsse." By Alphons von Dittmar. Munich, 1864.

"Notices Géologiques et Paléontologiques sur les Alpes Vaudoises et les Régions environnantes." By E. Renevier. Lausanne, 1864.

"Etudes sur les Etages Jurassiques inférieurs de la Normandie." By Eugène Eudes-Deslongchamps. Paris, 1864. F. Savy.

"On the Rhætic Beds and White Lias of Western and Central Somerset," &c. By W. Boyd Dawkins. 'Quarterly Journal Geological Society,' November, 1864; and 'Geological Magazine,' December, 1864.

"On the Rhætic or Penarth Beds of the Neighbourhood of Bristol and the South-west of England." By H. W. Bristow. 'Geological Magazine,' November, 1864. Read before the British Association at Bath, 1864.

The opinions expressed in these several memoirs are as various as they can be, for while Herr Waagen calls the Zone of *Avicula contorta* the uppermost member of the Keuper, M. Deslongchamps and M. Renevier consider it to belong to the Lias, the former positively, the latter more diffidently; then again, Herr von Seebach appears undecided, Mr. Boyd Dawkins* calls it the Passage-beds of the Lower Lias, and Herr Von Dittmar treats of it as a separate formation; but the last-named Geologist thinks that if it *must* be classed with one or the other formation, it should be placed with the Keuper, the balance of authority (!), he considers, favouring that view. The Geological and Palæontological evidence must indeed be conflicting, when it is found desirable to decide such a question by arbitration, and Herr von Dittmar almost proposes that this should be done. In general terms it may be said that the French and Italian Geologists consider

* We shall notice this author's paper at greater length under the head of "Proceedings of the Geological Society," p. 109.

the Zone of *Avicula contorta* to belong to the Lias, and that the German and English authorities find it more convenient to treat of it as a separate formation; but believe it to have a closer relationship with the Trias.

We have said enough to show that Geologists who have specially studied the subject are by no means agreed as to the best way of solving the difficulty; but the memoirs we have quoted all contain much valuable matter, independently of their bearing on this question. M. Renevier's paper contains a discussion on the exact meaning of the term Infra-lias, and he shows that it includes two sets of strata, which are perfectly distinct from one another in the region of the Vaudois Alps; for the lower zone he retains the name of Rhætic beds (Etage Rhétien), but for the upper he proposes that of Etage Hettangien. M. Deslongchamp's memoir is especially remarkable as containing a proposal to separate the Upper Lias of Normandy altogether from the Lias-formation, and to incorporate it with the Lower Oolite (Système Oolithique Inférieur), under the name of "Marnes Infra-Oolithiques," and in association with the Inferior Oolite, the Fullers' Earth, and the Great Oolite. This change, if adopted, would shift a battle-ground, which has hitherto been the "Upper Lias sands," or "sands of the Inferior Oolite;" but we doubt whether it will be generally accepted, and if accepted, whether matters would be improved thereby.

All the papers mentioned contain valuable lists of fossils, sections of strata, and detailed descriptions of the rocks in the several districts.

Professor Huxley's monograph "On the structure of the *Belemnitidæ*," has just been published in the Memoirs of the Geological Survey, and clears up many points in their organization that have hitherto remained more or less obscure. One magnificent specimen of a Belemnite, in the collection of the Rev. Mr. Montefiore, exhibits not only the guard, phragmacone, and pen, but also the general contour of the body, the beak, and some irregular lines of hooks indicating the position and extent of the arms. This is the most complete Belemnite ever found, and we therefore reproduce a reduced copy of the figures of it, illustrating Professor Huxley's description, especially as it gives us, with the author's aid, a clear insight into the structure and organization of the creature.

Amongst the many new points contained in this monograph, we must confine our attention almost entirely to one, namely, the systematic importance given to that rarely preserved organ which has hitherto been known as the "pen" or "osselet," but to which Professor Huxley has given the name of *pro-ostracum*, to avoid ambiguity, as he considers it to correspond to only a part of the structure known as the "pen" in recent Cephalopods. This osselet has always been a small bone of contention with naturalists, and the author, after a careful review of the works of previous writers on the subject, gives the following summary of their opinions:—

"1. According to Dr. Buckland, this part is a corneous, or shelly,

FIGS. 1 and 2. *Illustrating the Structure of the genus* BELEMNITES.*

FIG. 1.

FIG. 2.

FIG. 1.—*Belemnites*, in the Rev. Mr. Monteflore's collection, showing the guard (*a* to *d*), the phragmacone (*d* to *e*), the prostracum (*e* to *f*), which extended probably to *i*, the beaks (*k*), the position of the arms indicated by acetabular hooks (*l*), and the ink-bag (*m*). *x* indicates the point to which the phragmacone probably extends within the guard.

FIG. 2.—Magnified figure of two of the acetabular hooks (*see* Fig. 1 *l*).

* Reduced from Pl. I. Figs. 1, 1*a*, of Professor Huxley's monograph, by permission of the author.

and more or less completely nacreous, extension forwards of the lip of the phragmocone.

"2. According to Agassiz, it is a 'pen' identical with that of the so-called *Loligo Bollensis*, &c.

"3. According to Voltz, it is a 'pen' analogous to that of *Loligo Bollensis*.

"4. According to Mantell and Quenstedt, it is a broad dorsal plate, more or less corneous in the middle, and with two strong calcified asymptotic bands."

Professor Huxley's own opinion we have already given, but the most novel portion of his views on the subject, is the belief in the systematic importance of the variations in the form of the pro-ostracum, and on this account he is disposed to favour a subdivision of the genus *Belemnites* itself, "the difference between the pro-ostraca of *B. Bruguierianus* and *B. Puzosianus* being, probably, of generic importance."

Another new point is the direct proof, furnished by the specimen we have figured, of the existence of beaks and acetabular hooks in the genus *Belemnites* (*see* Fig. 1 *l* and Fig. 2); for though they have long been known to exist in *Belemnoteuthis*, they have never before been found in *Belemnites*.

Professor Huxley also describes a new genus of *Belemnitidæ*. In 1829 Sir Henry de la Beche figured and described a remarkable specimen from the Lias of Lyme Regis under the name of *Orthocera elongata*, the true nature of which has only recently been made out by the author, from the study of a very perfect specimen not long since discovered by E. C. H. Day, Esq., F.G.S., of Charmouth. Professor Huxley describes this and the original *Orthocera* at length, and, as the newly found specimen shows that the pro-ostracum belonged to a type distinct from either of those occurring in the genus *Belemnites*, he refers the two specimens to a new genus under the name of *Xiphoteuthis elongata*; he gives a full account of its relations to other *Belemnitidæ* so far as can be ascertained from the specimens, but states that several points are still unknown or obscure.

The second part of the Philosophical Transactions for 1864 contains the following papers by Mr. Prestwich, the first two having been incorporated together under the double title:—

1. Theoretical considerations on the conditions under which the (drift) deposits containing the remains of extinct mammalia and flint implements were accumulated, and on their Geological age.

2. On the loess of the valleys of the South of England, and of the Somme and the Seine.

3. On some further evidence bearing on the excavation of the valley of the Somme by river-action, as exhibited in a section at Deucat, near Abbeville.

In these papers the author discusses the mode of formation of the beds containing flint implements, and of the river-valleys in which they occur. He first shows that the gravel-beds follow, at various levels, the course of the present valleys, and have a direction of transport coincident with that of the present rivers; but the fact of some of the

gravel-beds being so much above the existing river-channels, combined with the occurrence in them of perfect and uninjured land and fresh-water shells, and the remains (sometimes entire) of land-animals of various ages, points to a former condition of things when such levels constituted the lowest ground over which the waters passed.

Mr. Prestwich then states that there is "evidence of great transporting power" in "the size and quantity of the débris," and of "floods of extraordinary magnitude," in the fact of "fine silt, with land-shells, covering all the different gravel-beds." Thus he believes the gravel-beds were accumulated and the valleys excavated by river-action of much greater intensity than that now in operation, "periodical floods imparting a torrential character to the rivers;" moreover, he considers that "river-action peculiar to each valley commenced with the high-level gravels," and that "the mass of débris and the large blocks present in the beds indicate the action of a large volume of water, and of ice-transport."

The author also connects the loess with both series of valley-gravels and with the existing river-valleys, regarding it as contemporaneous with the associated gravel-beds, and as representing the fine silt deposited from flood waters in such parts of the channel as are in a state of comparative repose, namely, "the lee side of the hills, lateral valleys, and plains, and any local depressions or hollows," while coarser material, represented by the present gravels, was left in the more central portions. He therefore concludes that, as in the case of the associated gravels, the higher deposits of loess were formed before the excavation of the valleys, and that those on the lower terraces are of later date.

Mr. Prestwich discusses also the probable antiquity of the deposits containing the flint implements, and he shows that though, geologically, they are posterior to the boulder clay, and consequently to the great extension of the European glaciers, yet that, chronologically, measuring their age by such natural chronometers as the excavation of the river-valleys, they must be so extremely ancient that all attempts to compute their age in hundreds of thousands of years are now, and probably always will be, utterly futile.

The 'Geological Magazine' continues to sustain its excellent character, the last four numbers having contained many important original papers, and a great number of abstracts and notices of interesting British and Foreign publications As might be expected some of the original articles refer to phenomena familiar to most geological students; such, for instance, is Mr. S. P. Woodward's article "On Banded Flints," in which the author strives to show that the coloured bands have been produced by infiltration, as taught by the late Professor Henslow. On the other hand, many of the papers are of a very recondite nature, but are nevertheless readable and interesting: such are the papers by Dr. Duncan and Professor Rupert Jones "On the Miocene Beds of the West Indian Islands;" Dr. Bigsby's "Description of the Laurentian Formation," &c. Mr. S. P. Woodward's paper "On *Plicatula sigillina*" is very short, good, and exactly suited to the Magazine in which it appears; but some other papers, consisting

of mere descriptions of species, are better fitted for the "Annals and Magazine of Natural History."

Proceedings of the Geological Society.

The last two numbers of the 'Quarterly Journal' of the Geological Society contain many important papers; but we have not space to discuss more than those relating to the following subjects, which appear to be of the most general interest, namely: (1) Recent Discoveries of Flint Implements in England; (2) Welsh Lingula-flag Fossils; (3) the Mineralization of Corals; and (4) the oldest known Mammal.

1. *Recent Discoveries of Flint Implements in England.*—Since the authenticity of the flint implements of the Valley of the Somme has been admitted by competent judges, very many amateur English geologists have confined themselves to the endeavour to discover these relics of ancient man in their own districts. That success has crowned the efforts of some of them is proved by the fact that since last July the Geological Society has published accounts of further discoveries of flint implements near Bedford, by Mr. J. Wyatt, in Hampshire and in Wiltshire, by Mr. John Evans, and in Gloucestershire by Mr. E. Witchell, and these memoirs teem with the names of fortunate finders of similar weapons in the different districts treated of.

The flint implements referred to in these papers all came from freshwater gravel-beds, as is proved by the shells found in association with them; but it is remarkable, in reference to the age of the deposits, that the molluscan fauna varies very little from that now living in the neighbourhood, while the mammals, as is well known, show a very great amount of difference. It should, therefore, be recollected that changes in a mammalian fauna indicate by no means so great a lapse of time as similar changes in a molluscan fauna do, and it would appear that even Mr. Evans places almost an extreme value on the mammalian evidence in the argument which leads to the following very temperate conclusion to his paper:—"Geologically speaking, indeed, the time may appear insignificant, as compared with the vast lapse of ages represented by even a single formation; but where man is concerned, we are involuntarily led to compare the period of his duration with the short space of time embraced by history and tradition."

2. *Welsh Lingula-flag Fossils.*—Last year Mr. Salter described some fragments of a large Trilobite belonging to the genus *Paradoxides*, until then unknown in Britain, and in a more recent paper "On some new Fossils from the Lingula-flags of Wales," he has given an amended description of the great *Paradoxides* (*P. Davidis*), and has also described several new species of fossils from Porth-y-Rhaw and Solva Harbours, near St. David's, including two new genera of trilobites, and a new genus of sponges. These fossils were obtained by local observers from beds hitherto considered almost unfossiliferous, but now shown to contain a large number of species; and according to

Mr. Salter the rocks of the same localities promise to yield still further additions to the English Primordial fauna. The chief importance of these fossils is, however, their bearing on the larger question of the distinctness of the Lingula-flags (or Primordial Zone as it is called), *as a formation*, from the great Silurian "System." This is one of the many questions to which field-geologists give one answer, and palæontologists another. But while palæontologists have always a definite principle to guide them, geologists are often obliged to resort to a theory of probabilities of their own manufacture,* or to use preconceived ideas in the place of facts which nature refuses to furnish. Palæontologically, if the Primordial fauna differs much more in degree from the Llandeilo than the latter does from the Caradoc, and the Caradoc from the Lower Llandovery, and so on; or if the Primordial fauna differs from the Llandeilo in facies, or kind, while the faunæ of the other stages have the same general facies in common; then the Primordial Zone is distinct from the Silurian "System," and *vice versâ*. Mr. Salter shows that the Primordial and Llandeilo faunæ are essentially distinct, and although some shells and a cystidean are of genera common to both formations, yet the entire distinctness of the trilobitic fauna overbalances this fact, the crustacea being the surest indices of the age of Palæozoic rocks, and, we may add, the molluscan genera having generally a very wide range. Mr. Salter thus gives his conclusion respecting the distinctness of the Primordial and Silurian formations: "The intervention of the whole of the Tremadoc rocks, containing a remarkable assemblage of fossils distinct from both, easily explains the meaning of this wide difference in the fossils [alluded to above], and indicates that the epochs of the Llandeilo and Lingula-flags were separated by an enormous period of time."

3. *The Mineralization of Corals.*—The third of Dr. Duncan's important memoirs "On the Fossil Corals of the West Indian Islands," is devoted to a mineralogical description of the specimens he has already treated of palæontologically. The mode of fossilization of various organisms has long been a subject with great attractions, but of greater difficulty; and few authors who have written on the subject, have hitherto endeavoured to explain the phenomena by means of arguments and theories founded on observed facts; † but most of them have had recourse to suppositious attractions, repulsions, and mutual movements of all kinds, between equally hypothetical atoms and molecules belonging to the large group of the "infinitely little."

Dr. Duncan, however, has patiently and laboriously noted the composition, texture, colour, &c., of every specimen he has already

* Since writing this sentence we have noticed the following passage in Mr. Prestwich's last paper on Drift Deposits containing Flint Implements:—"In looking back at the subjects we have discussed, we are forcibly reminded of our dependence on the value of probabilities. On various points Geology has not at present, and probably never will have, any other means of inference. All that can be done to give weight to our argument is to multiply probabilities, and by attending to the general concordance to reduce to the minimum the chances of error."—'Phil. Trans.,' 1864, p. 298.

† Petzholdt, Leopold Von Buch, and Bischof are among those who have treated this subject philosophically.

described palæontologically, and selecting those that best illustrate the several conditions of mineralization, he has arranged them into a very good paper, forming a capital basis for future researches on the general subject of fossilization. He has also done more than this for the special subject of the West Indian fossil corals, having determined and defined the following varieties of mineralization, namely, calcareous, siliceous, siliceous and crystalline, siliceous and destructive, siliceous cast, calcareo-siliceous, calcareo-siliceous and destructive, and calcareo-siliceous cast.

One very curious result in reference to the destruction and preservation of anatomical details has been arrived at by the author, and is thus stated :—"It would appear to be a rule that the minuter structural details of corals are best preserved when the animal tissues have been well washed out by the sea, and that the loss of these details bears a relation to the length of time the decomposing soft membranes remain in contact with the sclerenchyma."

Dr. Duncan's memoir is rich in remarkable cases of silicification, each one of which might form the basis of a good paper on the theory of the subject by an experienced chemist; in this place, however, we pass them by, as well as the author's own views on specially interesting cases, but we cannot help giving his chief and most important conclusion in his own words:—"Silica, whether homogeneous, granular, or crystalline, does not appear to be deposited at first in the interspaces of corals, but replaces a salt of lime which was infiltrated partly in solution, or partly in a state of mechanical suspension in a compound fluid. The replacement does not commence until the salt of lime has acquired a certain density, and it occurs *first of all in the central parts of the loculi, in the form of granular points.*"

4. *The oldest known Mammal.*—Mr. Boyd Dawkins's paper "On the Rhætic Beds and White Lias of Western and Central Somerset, and on the Discovery of a new Fossil Mammal in the Grey Marlstones beneath the Bone-bed," is a valuable contribution to the literature of the strata treated of, and adds greatly to our knowledge of them as they occur in Somersetshire; but the chief interest of the paper is centred in the latter part, in which is described a worn premolar tooth of a new Mammal, called *Hypsiprymnopsis Rhæticus* by Mr. Dawkins, and supposed to be the oldest known representative of the Mammalia.

The tooth has an oblong crown, the summit being obliquely worn, and exhibiting on its higher side, which adheres to the stone (*see* Fig. 3), two isolated involutions of enamel on that portion of the tooth that is supported by the posterior fang. In front of these are two wider and less prominent folds, and there may have been another on the anterior corner, which has unfortunately been broken by the waves.

It will be seen from Fig. 5, that the worn premolar tooth of *Hypsiprymnus minor* exhibits a very similar appearance, the traces of the plications being no more prominent than in the fossil, although in the unworn tooth of the same species (Fig. 4) they form so marked a feature. Again, on the lower or outer side of the former, as in the

FIGS. 3—5. *Illustrating the affinities of* HYPSIPRYMNOPSIS RHÆTICUS.*

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 3. Premolar of *Hypsiprymnopsis Rhæticus*, magnified four diameters.
FIG. 4. Unworn left lower premolar of *Hypsiprymnus minor*, magnified two diameters.
FIG. 5. Worn right lower premolar of *H. minor*, magnified four diameters.

fossil, there is scarcely a trace of plications, so that this character cannot well be used, Mr. Dawkins says, as an argument against the Hypsiprymnoid character of the fossil tooth.

Mr. Dawkins considers, therefore, the nearest living representative of the fossil to be *Hypsiprymnus minor*, "or some other of the kangaroo-rats with four plicated premolars;" but the fossil tooth is not more than half the size of the corresponding teeth in the recent species. The relation of *Hypsiprymnopsis* to *Microlestes* cannot be determined, because the tubercular true molars are all the remains that are known of the latter genus.

Hypsiprymnopsis Rhæticus was found by Mr. Dawkins on the seashore to the west of Watchet, in the hard arenaceous marlstones which yielded the first traces of life in the passage upwards from the red marls of the Trias. Its exact position was 10 feet 6 inches below the bone-bed, and therefore it is very probably, if not certainly, the oldest known trace of the Mammalia, for the Rhætic Mammalian remains hitherto found, namely, the Microlestian teeth of Frome and Diegerloch, were obtained from the bone-bed itself. The only doubtful question is, Does the bone-bed of Diegerloch represent exactly the same epoch as that of Frome and Watchet?—the English and German localities being far apart. Besides the distance of the localities, however, there is very little reason why the two bone-beds should not be contemporaneous, but there is equally little proof that they are.

* Fig. 3 was drawn from the original specimen, kindly lent for the purpose by Mr. Boyd Dawkins; Figs. 4 and 5 were copied from Figs. 4*a* and 4*b*, of Mr. Dawkin's paper in the 'Quarterly Journal' of the Geological Society, No. 80, p. 411.

VIII. MINING, MINERALOGY, AND METALLURGY.

Mining.

In every division of metalliferous mining in this country, there is a serious depression. This can be traced, in a great measure, to the disturbed condition of the American markets, which has tended to reduce the market prices of the metals. No branch of Mining has suffered so severely as the Tin Mines of Cornwall and Devonshire, and it may be safely asserted that, at the present moment, there are not ten Tin Mines in the West of England which are paying the costs of exploration. The high price of tin ore a few years since—85*l.* a ton being realized—induced adventurers to re-open many old tin mines, and to start new ones. The present price—60*l.* per ton—and even in some cases less than this, has left most of these without a chance of profit, even when the strictest economy is observed.

The system of mining which prevails in connection with our Western, and most of our Welsh Mines, is in the highest degree injurious, and by no means adapted to stand the depression which prevails at present, and which appears likely to continue.

The Mining Share Lists show that a very large number of our mines are worked by companies, divided into an unwieldy number of shares. Ten thousand shares are common; forty thousand not unusual; and fifty to seventy thousand are met with. A very large proportion of these shareholders really feel no interest in the legitimate prosecution of the mineral works, their interest being centred in the traffic in shares. The result of this is, that the mines are carelessly worked, the real business of exploration entirely neglected, and every stratagem is had recourse to for the purpose of giving a fictitious value to the shares in the market. At the present time, in even the best mines, every effort is made to produce the largest possible quantity of tin, that large apparent returns may be obtained, and dividends paid to the adventurers. Consequently, the metal market becomes overstocked, the prices of metal, and therefore of the ores from which it is obtained, still suffer a reduction, and absolute ruin must follow upon the unwise course which is being pursued.

In relation to mining for tin, we must not in our chronicles fail to record one of the most remarkable discoveries ever made in this country. The adventurers in the well-known Tin Mine, Great Huel Vor, sunk an enormous sum of money in reaching the bottom of the old mine, after it had been abandoned for more than twenty years. There was no tin in the depths of the mine, therefore all the money expended was lost. Immediately adjoining this mine, and forming, indeed, a portion of the property belonging to the company, was a small mine called Huel Metal. Attention was directed to this, and the result has been most satisfactory. The aggregate value of the different points of operation is considerably more than 1,000*l.* per fathom. "The lode at Ivey's shaft continues to improve, and is now worth between 250*l.* and 300*l.* per fathom. The 152 West of Metal

continues its value, above 200*l.* per fathom; and the 174 West has very much improved, being now worth about 50*l.* per fathom. The 184 (bottom level) is worth nearly 200*l.* per fathom. The 147 East of Ivey's, and the 147 West of Metal Shaft, are both very productive; and as these ends are within a few fathoms of each other, the important fact may be considered as established — that there is one continuous and rich body of ore from Ivey to Metal Shaft."* Such is the technical report of the managing agent. The known reserves in this mine have been estimated by a competent authority to be worth at least 200,000*l.*

The Copper Mines of Cornwall are regularly falling off in their production of ores. Indeed, nearly all the existing mines are giving indications of exhaustion. There are a few exceptional cases, for example, the production of the following mines which yielded yellow copper ore, as recorded in 1863, will be equally good in 1864:—

	Tons,		£
Devon Great Consols	26,694	value	128,576
Clifford Amalgamated	14,382	„	69,157
West Huel Seton	6,362	„	33,456
East Caradon	6,030	„	34,155
South Caradon	5,837	„	52,087
West Basset	5,387	„	31,204

Amongst the most remarkable of mining speculations which are at present engaging attention, notwithstanding the depression referred to, is the reopening of a very old and once celebrated Copper Mine, not far from Camborne, known as Crenver Huel Abraham. It is stated—and the statement may be relied on—that a contract has been taken to place this abandoned mine in working condition; that is, to clean up and open all shafts and levels, to erect machinery for pumping and winding, and to drain the mine, for 80,000*l.* In a district known as the Chiverton district, not far from Truro, upon the promise of one fortunate discovery, West Chiverton, which mine produced in 1863, 1,182 tons of lead ore, which gave also 27,269 ounces of silver, no less than fifteen mines have been started, each one involving an outlay of many thousands of pounds. Everyone who looks dispassionately at the present state of Metalliferous Mining, cannot fail to observe a most unhealthy action, which, it is to be feared, will only be remedied by the ruin of many of the ill-advised adventurers.

Twenty years since, Mr. Arthur Dean made known the existence of gold in the Quartz Rocks of Merionethshire. This gentleman has lately been appointed Consulting Engineer of the Vigra and Clogau and Welsh Mining Companies, and he has published a statement of some interest as to the production of Gold in North Wales. He writes—

"The mining territory belonging to the company is large, and the collective lengths of the principal lodes exceed 4½ miles.

"Some of these have, in former times, been extensively wrought

* 'Mining Journal.'

for copper ore, and are now found to be very auriferous; but as yet only a very small piece of one of the lodes, the St. David's, has been wrought expressly for gold. This piece has been cut off by a cross-course on the west, and is about 45 fathoms long, chiefly composed of quartz, largely impregnated with gold; the average yield of gold-bearing quartz is 10 tons per square fathom of the lode. The total amount of the lode extracted, including drivages, sinks, &c., is about 350 square fathoms, yielding 3,500 tons of mineral, good, bad, and indifferent, and of which between Jan. 12, 1861, and Sept. 3, 1864, the following quantities were crushed—

	Tons.				Oz.	dwts.	grs.
Rich picked ore, with visible gold .	39	9	yielding in gold		9,363	15	14
Poor ore, without visible gold . .	2,271	8	„		1,547	0	1
Total . . .	2,310	17					

	Oz.	dwts.	grs.	
Average yield of all the ore crushed . .	4	10	0	per ton.
„ „ the rich ore . . .	240	0	0	„
„ „ the poor ore . . .	0	13	15	„

"An experiment upon 1,036 tons of the poorest refuse from the lode, yielded $\frac{1}{4}$ oz. of gold per ton. Before St. David's lode was found to be auriferous, a large quantity of mineral, rich in gold, was extracted from it, and dressed for copper ore, and the gold was lost; but whatever the amount, it is included in the 3,500 tons extracted above mentioned.

"Worked upon a scale of (say) 50 tons per day, a yield of $\frac{1}{8}$ oz. of gold per ton will pay all costs; consequently, the lowest produce, $\frac{1}{4}$ oz. per ton, would leave half profit.

"At the Welsh Gold Company's Mines, near Tyn-y-Groes, an experiment upon one of the lodes has just been completed. A mass of 333½ tons has been broken out and stamped, yielding 282½ oz. of gold, or an average of 17 dwts. per ton as broken. The supply of mineral at this mine is, probably, greater than at any other gold mine in Wales, and preparations are now making to erect machinery, a large part of which is at the mines, to stamp 150 tons per day, the average yield being estimated at 10 dwts. per ton."

In connection with the subject of Gold Mining in Wales, it is right to record Dr. Crace Calvert's method of extracting gold from auriferous quartz, or from its combination with silver and copper. Finely-divided auriferous quartz should be intimately mixed with about one per cent. of peroxide of manganese, and common salt added at the same time as the manganese, in the proportion of three parts of the former to two of the latter. This mixture should be introduced into closed vats, having false bottoms with holes in them, upon which is laid a quantity of small branches covered with straw to prevent the powdered quartz from filling the holes. Diluted sulphuric acid is now added, in sufficient quantity to moisten the mass, and the whole allowed to remain in contact for twelve hours. Water should now be added so as to fill up the whole space between the false and true bottoms. This fluid should then be pumped up, and allowed to per-

colate through the mass. After this has been done several times, the fluid should be run off into separate vats, and the metals which it contains extracted. If silver is present, an excess of salt must be used in the process, for the purpose of holding in solution any chloride of silver that may have been formed.

Blades of copper placed in the saline solution precipitate the silver; then the copper is thrown down by metallic iron; and the gold is then extracted by adding to the fluid a concentrated solution of the sulphate of the protoxide of iron (green copperas), which throws down the precious metal in a metallic form.

In the Mendip Hills, mining operations on a very extensive scale were formerly prosecuted. So important was the *Myne-deeps* that a special code of laws was formed for the regulation of the mineral works upon those hills. Old slags and slimes are found spread over extensive districts, and these for some years have been turned to some small account. More important operations are just started. At the St. Cuthbert Lead Works near Wells, five new Catellan furnaces, a 30-inch cylinder steam-engine, two blast cylinders, and one of Bennett's condensers, are in process of erection. About 150 tons of good soft pig lead have been produced from this old débris within the last six months, but it is calculated that the new furnaces and blowing apparatus will yield 120 tons of pig lead a month.

The importance of the discovery of coal in our colonies cannot be overestimated. The following abstract of the Report of the official examiner, Mr. Mackenzie, of the coal-fields of the Illawarra district to the South of Sydney, is, therefore, of considerable interest. It has always been suspected that the Northern coal-field dipped under Sydney and reappeared at Wollongong. By a careful examination along the coasts of the superimposed strata, the connection of the two coal-fields has been established. The lay of the Wollongong coal-measures is traceable with tolerable clearness along the face of the sea-cliff. The top seam vanishes below the water-line at a point about thirty-four miles South of Sydney. It has been identified as reappearing above the water at Tuggerat Beach to the North of Sydney, and about seven miles South of Lake Macquarie. The Tuggerat Beach coal lies above the Lake Macquarie coal, and its identification with the Wollongong coal enables the section of the coal basin to be so far completed that the order of superposition between the Southern and Northern measures is determined. Two other outlying coal-measures are known to exist, one at Mittagong further South than Wollongong, and one above Stroud, North of Newcastle.

There are said to be twenty-six different seams of coal, averaging three feet in thickness, or containing 157 feet in thickness of coal. The strata in which these seams are imbedded represent a depth of 5,000 feet.

The Official Report concludes with the remark that these twenty-six seams do not form an exhaustive list of coal-measures, but include only those which have been so far examined as to be placed in their order. The collocation of other known seams awaits further investigation.

Near the Fitzroy Iron Mines a seam of coal thirty-eight feet in thickness has been discovered. This will, after making every allowance for waste, yield 30,000 tons an acre. At Illawarra a stratum of clay band iron-stone has been found, and shortly at Fitzroy the first Australian blast-furnace will commence operations with native material.

Amongst the Foreign mines, which greatly influence the English market, those of Chili are the most important. Recent returns of the produce of that country in the years 1861 and 1862, show the value of the minerals exported to this country—

	1861.	1862.
Cobalt ore	£17,980	£4,660
Copper ore	430,523	465,192
„ Regulus	736,290	1,211,340
„ Unwrought	275,555	204,421
„ Part wrought	228,388	302,965
Nitre, cubic	26,133	39,131
Silver ore	269,747	285,348

The following interesting notes on the new Almaden Quicksilver Mines are from the pen of B. Silliman, junior, of San Francisco:—

"The new Almaden Quicksilver Mines are situated on a range of hills subordinate to the main coast range, the highest point of which at the place is 1,200 to 1,500 feet above the valley of San José. Southwest of the range which contains the quicksilver mines, the coast-range attains a considerable elevation, Mount Bache, its highest point, being over 3,800 feet in height.

"The rocks forming the range in which the quicksilver occurs are chiefly magnesian schists, sometimes calcareous and rarely argillaceous. In geological age, they are probably not older than cretaceous. There is no such thing as a well-characterized vein of ore, the quartz and its associated metals occurring rather in isolated masses or bunches segregated out of the general mass of the metamorphic rocks, and connected with each other, somewhat obscurely, by thread veins of the same mineral. The principal minerals associated with the cinnabar are quartz and calcareous spar, which usually occur together in sheets or strings, and in a majority of cases penetrate or subdivide the masses of cinnabar. Sometimes narrow threads of these minerals, accompanied by a minute coloration of cinnabar, serve as the only guide to the miner in re-discovering the metal when it has been lost in a former working.

"The main entrance to these mines, at present, is by a level about 800 feet long, and large enough to accommodate a full-sized railroad and cars. This level enters the hill about 300 feet from its summit, and is driven into a large chamber, formed by the removal of a large mass of cinnabar, leaving ample space for the hoisting and ventilating apparatus employed in working the mine. At this point a vertical shaft descends to an additional depth of nearly 300 feet, over which is placed a steam 'whim,' by means of which the ore from the various workings is conveniently discharged into the cars which convey it out of the level to the dressing-floors. In order to reach the lower work-

ings, the observer may employ the bucket as a means of descent, or he may descend by a series of ladders and steps which are placed in various large and irregular openings or cavities which have been produced by the miner in extracting the metal, these cavities are often of large proportions, measuring sometimes 150 feet × 70 feet × 40 feet in height, communicating with each other sometimes by narrow passages, and at others by arched galleries cut through the unproductive serpentine.

"Some portions of the mine are heavily timbered, while in other places columns or arches of rock are left to support the roof.

"The cinnabar occurs chiefly in two forms, a massive and a subcrystalline. The first is fine granular, soft and easily reduced to the condition of vermilion; the other is hard, more distinctly crystalline, compact and difficult to break. It is occasionally seen veining the substance of greenish white or brown compact steatite or serpentine. The ores are extracted by contract, the miners (who are principally Mexicans, being found more adventurous than Cornishmen) receiving a price dependent upon the greater or less facility with which the ore can be broken. The price paid for the harder ores in the poorer parts of the mine is from three dollars to five dollars per cargo of 300 lbs. All the small ores and dirt hoisted from the mine are made into 'adobes,' or sun-dried bricks, for the purpose of building up the mouths of the furnaces in which the quicksilver is separated, to sustain the load of richer ores. No flux is used in these furnaces, there being sufficient lime associated with the ores to aid the decomposition of the sulphurets.

"The furnaces are built of brick, in dimensions capable of holding 60,000 to 110,000 pounds, and are fired from a lateral furnace fed with wood; connected with the furnace is a series of lofty and capacious chambers, through which all the products of combustion are passed, and all the available mercury condensed. Great care is now taken to prevent the escape of mercury through the foundations into the earth by building in the brickwork plates of iron, thereby cutting off all descending particles of the metal and turning them inward.

"Very great discoveries have recently been made at these mines. At one of the new openings a deposit of the richest description of cinnabar has been discovered, which, so far as hitherto explored, has a linear extent of at least 70 or 80 feet, and in point of richness has never been surpassed by any similar discovery in the past history of the mine.

"The process of reduction of the mercury is very simple, the time occupied from one charge to another is generally about seven days. The metal begins to run in from four to six hours after the fires are lighted, and in sixty hours the process is completed. The metal being conducted through the condensing chambers through iron pipes, which discharge into capacious kettles, after which it undergoes no further preparations for the market.

"The produce of the new Almaden Mines for the last ten years has averaged about 2,500 flasks, of 76½lbs. each, of mercury per month. The selling price at San Francisco is, at present, 75 cents per lb.,

while in London and New York it has ranged from 40 cents to 50 cents per lb."

The South Wales Institute of Mining Engineers have recently held their annual meeting, under the presidency of Mr. Alexander Bassett, of Cardiff. At this meeting, Mr. Greenwell communicated a paper on "The Copper Sands of Cheshire," and "The Alderley-Edge Copper Mines." Mr. Mather had a detailed description of "The Machinery used in Boring Artesian Wells." The President read a paper on "The Port of Cardiff, and the Aberdare Coal Fields. Besides those, were communications "On Utilizing Pit Tips," by Mr. W. Monks; "On the Nature and Manufacture of Patent Store Bricks;" and "On Re-Utilization of Slag from Blast Furnaces." Nothing can be more satisfactory than the progress made by this Institute.

We regret to record the death of the Glasgow Mining School. With every desire manifested on the part of the working miners to avail themselves of the information to be obtained in this school, it was found impossible to raise the necessary funds for its support amongst the wealthy coal owners of Scotland. This indicates a strange blindness to their own best interests; but it prevails in other mining districts than Glasgow.

Mr. Low writes us:—"With respect to the working of my patent boring machine" (described by him in detail, page 583, Vol. I. of this Journal), "it has worked most satisfactorily, together with the new air machinery, which I have constructed for working the same underground. Although the machine I have made works very well (in which provision was made for the tool to propel at three or four different speeds), yet I found a slight alteration needful, inasmuch as the progressive motion is so very varied. The alterations I am now effecting will perfect the machine, and where the three following important features will be obtained:—1st. That the tool will progress as it cuts just in proportion to the nature of the rock. 2ndly. The necessary gear and screw for propelling the tool will be done away with, and the tool will progress by the same agent as works the machine, and which will prevent the tool and piston from crystallizing (caused by the very rapid percussive blows), which affects the necessary gear and screw seriously. 3rdly. There is also a cushion of air to receive the back blows, which will also prevent the crystallizing of the working parts."

Mineralogy.

At a recent meeting of the German Association of Naturalists, M. Rose read a paper on "Meteorolites." He divided those containing iron into three classes—*meteoric irons*, *pallasites*, and *mésosidérites*. He proposed, also, a division of meteoric stones into seven classes—*chondrites*, *hawardites*, *chassignites*, *chladnites*, *shalkites*, *charbonites*, and *eukrites*. A new mineral, discovered in a crystal by M. Rose, in a meteoric iron, was described, to which the name of *rhabdite* was given. Numerous papers, of more or less interest, were read; amongst others, one on "The Composition of Felspars," by

M. Tschermak, and one by M. Knopp "On the Tendency to Recomposition in Micas and Felspars." This last paper bears importantly upon the formation of our kaolins or porcelain clays.

M. Hautefeuille, working under the direction of M. H. Sainte Claire Deville, has communicated to the Academy of Sciences of Paris a note on "The Artificial Production of Sphéne and Pérowskite." For some years past, the laboratory of M. Sainte Claire Deville has been devoted to investigations of this class, and many of the rare productions of Nature have been reproduced, thus explaining some of the most complicated actions which interest us in the inorganic world. The artificial crystals had the following composition :—

	Sphéne.	Pérowskite.
Silica	30·9	—
Titanic acid . . .	41·3	59·0
Lime.	27·8	39·0
Loss	—	2·0

The density of the artificial *sphéne* is 3·45, that of the natural crystals 3·6. The density of the artificial pérowskite is 4·0, the natural being 4·02. At a yet more recent meeting, M. St. Claire Deville communicated the results of the continued researches of M. Hautefeuille, on the *titanates* and some *silicates*.

M. Haidinger has communicated to the Academy of Sciences of Vienna a description of a meteroic mass, which fell at Trebizonde in December last, and a note upon a specimen of native iron, recently found amongst the collections of the Museum of the University of Zurich. The meteoric character of the former appears to be, according to M. Haidinger, open to doubt ; the latter specimen, which was labelled *Native Iron—very rare*, from Styria, possesses all the characteristics of genuine aërolites.

M. Daubré announces that M. Descloiseaux has discovered crystallized carbonate of soda in the meteorite of Argueil. This is the first time that alkaline carbonates have been found in bodies of meteoric origin.*

The *chladnite* of the Bishopville meteoric stone is proved to be a magnesian pyroxene, by J. Lawrence Smith, Professor of Chemistry, Medical Department, University of Louisville. In 1846, Professor C. U. Shepard published an account of this exceedingly interesting meteoric stone, that fell at Bishopville, South Carolina, in 1843, differing in its external character from other meteoric stones, the fractured mass being exceedingly white, except where metallic iron and other associate minerals occurred. The composition of the snow-white mineral (constituting about 90 per cent. of the entire mass), as given by Professor Shepard, is :—

Silica	70·41
Magnesia	28·25
Soda	1·39

From the results of this analysis, he considered it a tersilicate of

* 'L'Institut,' No. 1606.

magnesia, consituting a new species, to which he gave the name *chladnite.*

Several years after this examination, Professor Smith has obtained fragments of the meteorite, and has been able to separate the "chladnite" perfectly pure, and in sufficient quantity to submit it to a thorough analysis, the result of which shows the composition of the mineral to be—

		Oxygen Ratio.
Silica	60·12	2
Magnesia	39·45	
Peroxyde of iron	·30	1
Soda	.74	
	100·61	

Corresponding to the formula $Mg^3 Si^2$ equivalent to the general formula of pyroxene $R^3 Si^2$. The minute quantity of peroxyde of iron came from exceedingly fine particles of iron diffused through the minerals, and could be seen by a magnifying glass.

"Chladnite" approaches those forms of pyroxene known as white augite, diopside, white coccolite, &c.; these last-named minerals having a part of the magnesia replaced by lime. It is identical in composition with Enstatite of Kengott, a pyroxenic mineral from Aloysthal, in Moravia.

From these observations, it will be seen, that the Bishopville meteoric stone, however different in external characteristics from other similar bodies, is, after all, identical with the great family of pyroxenic meteoric stones.*

In our last Number we recorded the discovery of *Langite*, a new mineral in Cornwall, by Mr. N. S. Maskelyne. This mineral has been analyzed by M. Pisani, who gives the following as its composition :—

Sulphuric acid	16·77
Oxide of copper	65·92
Lime	0·83
Magnesia	0·29
Water	16·19
	100·00

This gives the formula $(Cu)^4 S + 4$ aq. *Langite* differs from *brochamtite*, by its containing one equivalent more of water.†

Devilline is the name given to a new mineral species from Cornwall, associated with *langite.*

This mineral is of a lighter colour than langite, and of a fibrous lamellar structure, with a milky lustre. Composition according to Pisani—

		Oxygen Ratios.
Sulphuric acid	26·65	3
Oxide of copper	51·01	
Lime	7·90	3
Protoxide of iron	2·77	
Water	16·60	3

* 'Silliman's Journal,' Sept. 1864. † 'Les Mondes,' Nov., 1864.

Giving a composition 3 R S + 3 H, where R is equal to (Cu Ca Fe), or a hydrated subsulphate of copper, of a more basic character than either langite or brochantite, having a portion of the protoxide of copper replaced by lime. That the lime is actually in combination is proved by the fact that no intermixture of gypsum could be detected by a polarizing microscope.*

Evansite is a new mineral species, which has been described by Dr. Forbes, F.R.S.

This mineral was brought from Hungary in the year 1855, by the late Mr. Brook Evans, of Birmingham, and was then reported to be found in some abundance, as an incrustation, in drusic cavities which occurred in the brown iron ores. It was regarded as pertaining to the mineral species *allophane*, with which it agrees in many of its physical properties, as hardness, colour, specific gravity, &c., as well as in percentage of loss sustained upon heating the mineral to redness.

The specimen received from Mr. Evans was labelled "Allophane, from Zsetcznik, Gomar Comitat," and was very beautiful in appearance, consisting of an agglomeration of small stalactites, with reniform and globular excrescences on brown hæmatite, many of these excrescences much resembling artificial or natural pearls, having both the figure and characteristic pearly lustre of each.

The identity of the mineral with allophane being doubted, a preliminary blow-pipe examination immediately confirmed this opinion by proving the absence of silica in any quantity, and indicating the presence of phosphoric acid; consequently, Dr. Forbes was more disposed to regard it as hydrargyllite or Gibbsite.

The physical characters of *Evansite* are as follows:—Amorphous, and without trace of crystallization; reniform or botryoidal, colourless or milk-white, and sometimes faintly tinged with yellow or blue, and occasionally presenting iridescent hues; streak white, translucent to semi-opaque. Lustre, vitreous or resinous; splendid and waxy internally; very brittle. Fracture, semi-conchoidal and shining.

Hardness 3·5 to 4; specific gravity 1·939. Analysis:—

Water	39·95
Phosphoric acid	19·05
Alumina	39·31
Insoluble (silica)	1·41
Loss	0 28
	100·00

From which the following formula may be safely deduced:—3 $Al^2 O^3$, 9 PO^5 + 18 HO.†

There is a remote—and but a remote—connection between the subject we chronicle and the process of artificial petrifaction announced as discovered by Professor Efisio Marini, of Sardinia. It will be remembered by many, that a Venetian gentleman exhibited

* 'Les Mondes,' Nov., 1864. † 'Phil. Mag.' Nov., 1854.

some years since portions of the human body most thoroughly silicified, yet still retaining their natural colour. This process was lost, with the inventor of it. M. Marini, however, supposes that he has rediscovered the process of Girolamo Segato. It is stated that animal substances are petrified most readily by simple immersion in the bath of M. Marini; that they retain their colour, and are rendered absolutely indestructible. As an ingenious imitation of processes which are constantly going on in nature, and which it serves to explain, the announcement of this discovery finds a place in these pages.

M. Kuhlmann read before the Académie des Sciences of Paris, in October, the second part of his researches on "Crystallogenic Force." He applies this name to the tendency which molecules of the same nature have to form crystals. It is not a little curious to find the researches of Dana entirely ignored, and his admirable essay on Crystallogenic Force forgotten. The reader of Kuhlmann's paper would suppose that the idea of this force, as an independent energy, had originated with him, and that the name was his especial coinage, whereas the American Mineralogist has employed the term for a long period, in his large work, and has examined with great care, many of the phenomena involved in the consideration.

M. Kuhlmann's researches are of very considerable interest, and are leading, it would appear, to a solution of some of the difficulties which at present surround the laws by which crystallization, or the natural grouping of molecules into a geometric solid, is produced. The memoirs are too extensive to be reproduced, and they do not admit of condensation. The student of this interesting branch of physical science is, therefore, referred to the journals of the French Academy of Sciences.* M. Morin directed the attention of M. Kuhlmann to the spontaneous crystallization of iron—a question which still requires a close and searching examination. In connection with this, it may be noted that Mr. Paget, C.E., in May last, before the Society of Arts, and lately a correspondent to the 'Engineer,' has pointed out that wrought iron is rendered more or less brittle by strains in excess of the limits of elasticity; that a crystalline fracture is produced by any sudden rupture; that a state of brittleness, whether due to defective manufacture or to excessive strains, would render a bar peculiarly liable to rupture under impulsive forces; that rupture under such circumstances must be sudden, and, consequently, crystalline in appearance.

At a more recent meeting of the Académie des Sciences, M. Kuhlmann exhibited a great many reproductions—by photography, electrometallurgy, and nature printing—of crystallizations upon glass plates, and which he calls crystalline tablets. This is an especially interesting mode of obtaining and preserving the forms of crystals for study.†

* 'Les Comptes Rendus.' 'L'Institut,' No. 1606. 'Les Mondes, Revue Hebdomadaire des Sciences,' Oct. 6 and 20, 1864.

† 'L'Institut,' No. 1607.

Metallurgy.

At the meeting of the Académie des Sciences of Paris, on the 7th November, M. Pelouze, in the name of M. Leguer, presented a note relative to the effects of Wolfram upon Charcoal Iron. It would appear from this note that the addition of but a very small quantity of either wolfram or tungsten increased the tenacity of the iron, and its resistance to fracture.

M. Margueritte, who has devoted considerable attention to the manufacture of steel by cementation, has combated the views of M. Caron, who inclines to the idea that combinations of carbon with nitrogen (cyanides) were necessary to the production of steel; that, in fact, steel could not be made unless nitrogen, in some state of combination, was present. His words are—"Toutes les fois qu'on cémente le fer industriellement on le met constamment en contact avec du cyanhydrate d'ammoniaque gazeux ou des cyanures volatils. Dans la pratique les cyanures seuls cémentent." This view has been entertained by several English metallurgists. The results of a very extensive series of experiments, under almost all the desired conditions, are thus expressed by M. Margueritte:—"I maintain, then, my conclusions, which are absolutely contrary to those of Mr. Saunderson and M. Caron. Mr. Saunderson has pretended that pure carbon will not convert iron into steel; and M. Caron has said—'Cyanures (cyanides) are the only agents of cementation.' I believe I have proved that pure carbon (the diamond), and also the oxide of carbon, can transform iron into steel; and that they should be counted amongst the most active and abundant elements in the processes of cementation."‡ To this M. Caron has replied by enumerating some new experiments, which lead him to the conclusion, that "Ces agents de carburation sont insignifiants dans la pratique, et s'ils méritent d'être comptés c'est parmi les *moins actifs* et les *moins utiles* de la cémentation industrielle."* So the discussion rests at present, although M. Margueritte replied to M. Caron at a more recent meeting of the Academy.

A patent has been secured for a new process, by which the surfaces of iron castings may be hardened. When a piece is filed up, or finished, it is brought to a cherry-red heat, and then immersed till quite cold in a solution composed of 1·080 grammes (of 15½ grains each) of sulphuric acid, and 65 grammes of nitric acid to 10 litres (about nine quarts) of water. The patentee informs us that the iron suffers no distortion, and that the stratum hardened is sufficient for all ordinary purposes.

In a previous page we have noticed Dr. Crace Calvert's process of treating gold ores. Mr. Beelback, of Newark, U.S., has patented an improved process for separating silver and gold from lead. He melts the lead containing these metals in a furnace with an inclined hearth, then draws it off into a kettle in which is a proper quantity of zinc to take up the silver and gold. After being well stirred together, this mixture is run into pigs or masses of a suitable size for re-melting.

* 'L'Institut,' No. 1603. † 'L'Institut,' No. 1606.

These blocks are placed on a furnace with an inclined hearth, and subjected to a low degree of heat, sufficient to cause the lead to melt and run off, but not to melt the zinc, silver, and gold.

A discovery, which promises to be an important one, has been made by M. Basset, of Paris, in the process of reducing the chlorides of aluminium. It is that the metalloids and metals which, by double decomposition, will form more fusible and more volatile compounds than the chloride of aluminium, may be employed in reducing the latter. Zinc is used in preference to any other metal. When the chloride of aluminium is brought into contact with zinc, at a temperature of from 250° to 300° *centigrade*, a chloride of zinc and free aluminium is formed. This latter will dissolve in an excess of zinc, and the chloride of zinc combining with the chloride of sodium, the mass becomes thick or pasty, and eventually solid, while the alloy of zinc and aluminium remains fluid. If the temperature of the mass is raised it again liquifies, and the zinc reduces another portion of the chloride, and the excess of zinc becomes enriched with an additional quantity of aluminium The rich alloy is then melted with the addition of more chloride of aluminium, and kept well stirred until very nearly pure aluminium is obtained. The small quantity of zinc remaining is volatilized at nearly a white heat, and pure aluminium is obtained. If this process answers upon a more extensive trial, aluminium will be produced at a much cheaper rate than hitherto, the great cost in its manufacture at present being due to the sodium employed.

Amongst the curiosities of modern metallurgy, we must regard some of the enormous castings which are made by our iron manufacturers. At the end of October, Messrs. J. M. Stanley and Co. cast two anvil blocks, each weighing 160 tons. The mould was twelve feet square at the base, and eleven feet six inches deep. This was dug out in the centre of the workshop, and from five furnaces constructed around the building the molten iron was run. The first furnace was tapped at six o'clock in the morning, and twelve hours were necessary to fill the mould. This enormous mass of iron took six weeks to cool, and it was then, by means of hydraulic power, lifted from the mould.

These anvils are intended for the gun-manufactory of Messrs. Firth and Sons, and each anvil is prepared to receive the blows of a twenty-five ton Nasmyth hammer.

Mr. Griffith's puddling machine, which we noticed in a former number, promises to produce a revolution in the puddling system. It is being adopted in several iron works. An experienced correspondent writes:—"The puddlers are treating the 'Iron man' as a friend and helper. It is not to be expected that this machine, or any other, will supersede entirely human skill and exertions. The judgment, attention, and practical skill of the puddler, will always be required; but this apparatus will lessen very much the physical toil now endured, and it more than pays for its application in the increased quantity and better quality of the work accomplished."

IX. PHYSICS.

LIGHT.—We have very few facts to chronicle this quarter in Physical Science. One of the most valuable contributions to our knowledge of the phenomena of Light has been made by Mr. Dibbitts,* who, in a paper on the Spectra of the Flames of various Gases has recorded observations made on the flame of hydrogen burnt in air, in oxygen, in nitrous and nitric oxide, and in chlorine; also of carbonic oxide and cyanogen, burnt in air, oxygen and nitrous oxide. The flames of ammonia, sulphuretted hydrogen, and of some other gases have been also examined under various conditions, the whole forming a most valuable contribution to our knowledge of the subject. A curious fact discovered by the author is, that a solution of sulphate of quinine does *not* fluoresce with the light of the flame from hydrogen, hydrocarbons, and ammonia, but does with the flame of carbonic oxide, cyanogen, sulphur, and indeed all sulphur compounds. When fluorescence does take place, it is always stronger with the flame in oxygen.

It is well known that Santonine is coloured yellow by exposure to solar light, and this takes place in a vacuum as well as in air. It does not take place, however, when the actinic rays are cut off by means of a solution of nitrate of uranium. This phenomenon has been examined by M. Sestini,† who finds that Santonine when exposed to solar light is changed into formic acid, and an uncrystallizable substance much more soluble in alcohol and ether than santonine itself, and also a rod resinous substance. To the yellow uncrystallizable substance the author has given the name of *photo-santonic acid.*

Some living specimens of the *Cucuyos*, or fire-flies (*Elater noctilucus*), coleopterous insects, very common in Mexico, have lately been brought to Paris, where they have created quite a *furore*, not only amongst the Parisian belles, who are anxious to put them to the same use as the Mexican ladies, but also amongst scientific men. They were exhibited at the Academy of Sciences, at their sitting on the 19th of September, where M. Pasteur read a paper on the properties of their phosphorescent light. The light emitted by these insects is so intense that one will enable a person to read in the dark at a short distance from the animal. Mexican ladies ornament themselves for evening parties with the insects, keeping them for the purpose, feeding them on sugar, and giving them a bath once or twice a day. The light examined by the spectroscope gives merely a continuous spectrum, very beautiful, but without lines. The author made the same observation with the light of glowworms. As it seems possible to preserve these creatures for a considerable length of time, and as Mexico is now in constant communication with Paris, some enterprising artificial florist will, no doubt, import them regularly next season.

Some valuable improvements in the production of light from gas have recently been brought forward by the Rev. W. R. Bowditch.‡

* 'Poggendorff's Annalen,' August, 1864.
† 'Bulletin de la Société Chimique de Paris,' 1864, p. 21.
‡ 'Chemical News,' vol. x. pp. 192, 216.

The principle of carburetting coal gas has already been adopted in other cases, but this method differs from all others hitherto in use by the inventor employing naphthaline, and the heaviest hydrocarbons, as the carburetting agents. These are placed in a gas-tight metallic box, into which are soldered two gas-pipes, one for conveying gas into the box, and the other for conveying gas and vapour out of the box into the burner. The burner is fixed to the outlet pipe, and is so placed that when gas is being burnt, the hot air from the gas flame must impinge upon the box. This box is provided with a screw-plug through which the hydro-carbon is put in, and this plug is closed during use. The box being supplied with hydro-carbon, or *carboline*, as the inventor styles the materials employed, is connected with any ordinary gas-fitting, and the gas is lighted. At first the gas passes over the surface of the hydro-carbon without being affected, but when the temperature has risen sufficiently to convert the hydro-carbon into vapour, the passing gas carries with it a quantity of this vapour, and the flame becomes highly illuminating, the illumination being proportional to the quantity of vapour present in the flame. As may be imagined, the increase of light is enormous, as will be seen from the following statement:—In London 1,000 feet of gas, costing 4*s.* 6*d.*, give the light of 1,500 candles, when burnt in flat flame-burners. An addition to this of 4½ lbs. of carboline, costing about 9*d.*, raises its light to that of 7,500 candles. The apparatus is perfectly safe, and gives no trouble. In some experiments made and verified by one of our staff, it was proved that the light given by gas passing through the carburetter at the rate of three feet per hour, was eight times greater than the light given by ordinary gas burnt under precisely similar conditions, at the rate of three-and-a-half feet per hour.

Some curious effects of the action of light upon some copper salts have been noticed by M. Rénault. When copper is plunged into any liquid capable of abandoning chlorine more or less easily, it becomes covered with a greyish white coating consisting of protochloride of copper. This salt is remarkable for the facility with which it alters when exposed to sunlight; its greyish white colour gradually deepens to black, and assumes a coppery metallic appearance. A photographic negative placed on a copper plate rendered sensitive in this manner gives a remarkably fine positive; and when the coating of chloride is sufficiently thin, the redness of the copper seen through the transparent light parts gives a more agreeable tone than is possessed by the old daguerreotype pictures. If the dry white crystalline protochloride is spread on paper, and exposed to the sun, no alteration takes place so long as the dry condition is maintained; but on the addition of a few drops of water, each portion of the moistened protochloride paper assumes successively yellow, grey, black, and violet tints. The analogy between the properties of chlorine, bromine, iodine, fluorine, and cyanogen, led M. Rénault to investigate whether analogous photographic compounds might not be furnished with those bodies. He has accordingly obtained photographs with bromide, iodide, and fluoride of copper, the bromide being considerably more sensitive than either of the other compounds. In the early days of the daguerreotype

process it was frequently remarked that polished copper-plates iodized in a similar manner to silver ones, were also sensitive to light.

In a paper on the crystallogenic force, M. Kuhlmann has applied photography to the reproduction of some phenomena of crystallization. He coats glass with a solution of sulphate of magnesia thickened with gum, after the plan adopted by barbers and others, who ornament their windows in this way. The prettiest effects are obtained with a solution of sulphate of zinc, and the appearance may be improved by painting over the crystallization with an alcoholic solution of some colouring matter, such as fuchsine. In order to perpetuate these appearances, M. Kuhlmann has thought of copying them by photography. With Mr. Bingham's assistance, he obtained some beautiful pictures on collodion plates, and also copied the crystallizations directly on paper. The galvano-plastic method of reproducing these crystalline forms, so as to be able to print them upon paper or fabrics, was also tried. For this purpose the crystallization was obtained upon a thin plate of copper, and it was copied by putting this plate on another through a powerful rolling machine. The forms were beautifully preserved, notwithstanding the great pressure, and the plates could be used for printing, as soon as they came from the rollers. The designs may also be copied by pressing gutta-percha on glass plates covered with the crystals; the gutta-percha moulds may then be copied by the electrotype process. It was suggested that this style of ornamentation might be substituted for ordinary chasing on articles of gold and silver, and a specimen so ornamented was exhibited to the Academy. The author pointed out that no two crystallizations are obtained exactly alike. They can only be copied by photography, for the fineness of the designs would defy the *burin* of the most clever engraver; he therefore suggests that the designs would be useful for bank-notes. Copper-plates might be obtained in the way described, and if the design were printed in pale blue ink, on a bright yellow ground, the photographer and the engraver would both be defeated in obtaining a counterfeit.

A very excellent substitute for yellow glass, for the purpose of excluding the chemical rays of light, has been suggested by Mr. W. Sydney Gibbons, of Melbourne. He dissolves gelatine and bichromate of potash together, and with the hot solution coats slender fabrics. It leaves no pinholes, gives a clear orange tint, is perfectly weatherproof, and is so firm, that it admits of the use of a slight fabric, which does not itself obstruct the light. Mixed with lampblack the mixture makes a good and lasting pigment, which is admirably suited for a black board, as it stands any amount of washing after it has been actinized. The gelatine and bichromate of potash mixture, either with or without pigments, is a good material for coating bottles of substances which require darkness, as the copper solution for sugar testing, chlorine water, nitrate of silver solution, &c., the bottle only requiring to be dipped in a moderately strong warm solution.

A new binocular microscope is spoken of as having been invented in America, which is said, in 'Silliman's Journal,' to be in "every way superior to Mr. Wenham's ingenious arrangement." The inventor

of this instrument, which will set microscopists wondering, is Mr. Tolles, of Canistota, New York, long favourably known by the great excellence of his objects for the microscope and telescope, who, it is said, has advanced one step farther than Mr. Wenham. The writer of the notice by no means wishes to depreciate Mr. Wenham's invention, so freely made public, and undoubtedly the best hitherto devised; but with the new binocular eye-piece, and an objective of two-thirds, there was a marked difference in the definition by reflected and direct vision. The division of the pencil is effected so far from the objective, that the interference with definition is a minimum. The tubes are symmetrical and *parallel*, and are adjusted for different eyes by a screw and milled head, giving a range much greater than can ever be required; and no alteration is required for the adaptation of the eye-piece to any microscope, as it is used in precisely the same manner as the ordinary eye-piece. It lengthens the microscope, however, about four inches, though not necessarily so much. The eye-piece, with its present arrangement, is a first-class erecting one, giving with the various powers, up to four-tenths, full and clear fields, beautifully illuminated by the mirror alone, and without any special trouble with the higher powers, as is the case with Mr. Wenham's arrangement. The writer speaks rapturously of the appearance presented under the new eye-piece by such objects as Aulacodiscus Petersii, transparent injections, living Diatoms and Desmids, &c., but he declares that he is not at liberty at present to explain the principle upon which Mr. Tolles has been enabled to divide the pencil so far from the objective, but he declares it to be theoretically, as well as practically, correct, though it is so simple that he wonders that it did not at once occur to those eminent European opticians, who have devoted so much time and skill to the perfection of the binocular arrangement. The eye-piece works well when applied to the telescope, but the stereoscopic effect is not equal to that produced when applied to the microscope, owing to the small angle of the object-glass.

Mr. Chadburn, optician of Liverpool, has patented a new Oxy-calcium Lantern, which throws enlarged images of opaque objects on a screen, the same as the magic-lantern projects transparent ones; so that with it ordinary prints, photographs, sketches, drawings, diagrams, &c., are delineated with all their colours. Coins, medals, relievos, &c. are shown with the same accuracy. The effect produced by exhibiting a watch face with hands moving is very striking. Coloured *cartes de visite* have all the charm of oil paintings. In this particular, the instrument will be of great service to the artist, for he will be enabled thereby to throw enlarged pictures upon his canvas to any proportion, and follow every lineament with the pencil, without having the trouble of photographic manipulation on so large a scale. The instrument is most simple in its construction and management. The light used is the oxy-hydrogen. The rays from the lime cylinder, which is placed in the centre of the box, are received upon a large concave mirror and reflected to a 9-inch condensing lens, which concentrates the light upon the object to be enlarged; and this object is placed at an angle of about 45° to allow of the object-glass (double acromatic combina-

XUM

tion) to receive the illumined picture. The axis of the objective must be perpendicular to it, and also out of the angle of reflection, the object-glass refracting the image upon the screen.

HEAT.—By far the most valuable series of memoirs relating to the science of heat, have been lately published by Professor Tyndall. It would be out of our power to give, even were we to largely exceed the space at our disposal, an abstract of these important researches. We may, however, state briefly some of the results at which this indefatigable experimentalist has arrived. The researches have been mainly directed to the obscure, extra red rays of the spectrum; and as rock salt is the only known solid transparent substance which allows all of these dark heat rays to pass through with equal facility, the research has been delayed in its earlier stages by the difficulty of getting clear pieces of this mineral of a sufficient size. This difficulty is, happily, now overcome, and Professor Tyndall has lately had made for him a complete rock-salt train of a size sufficient to permit of its being substituted for the ordinary glass train of a Duboscq's electric lamp. A double rock-salt lens placed in the camera renders the rays parallel; the parallel rays then pass through a slit, and a second rock-salt lens placed without the camera produces at an appropriate distance an image of the slit. Behind this lens is placed a rock-salt prism, and a thermo-electric pile is employed to examine the spectrum produced by the prism. With both gas and hydrogen flames the maximum of heat is obtained, when the pile is placed outside the visible spectrum, a little beyond the red end. This was to be anticipated from the experiments of Sir William and Sir John Herschel. When a spiral of platinum wire is introduced into the hydrogen flame, the radiation of heat is increased from 33° to 52° as measured by the galvanometer. The action of heat on the pile was still very sensible when it was removed away from the red end of the spectrum as far as that is from the violet, thus proving that the heat spectrum is at least as long as the light spectrum. Upon substituting for the flame a coil of platinum wire, which could be rendered incandescent by a small galvanic battery, and placing the thermo-electric pile in the position of maximum heat in the spectrum, the intensity of the current which ignited the spiral was gradually increased from darkness to a full white heat. The deflection of the galvanometer, which at the dark heat was 1°, rose to 18° at a red heat; 44·4 at a bright red heat, and at a full white heat it was 60.° It will be observed that as the *refrangibility* of these heat rays remained unaltered, their increased intensity was due to greater *amplitude* of the vibrations. Allusion has been made on a former occasion to the transparency of an optically opaque solution of iodine to the ultra-red rays. More accurate experiments have shown that with intense sources of heat this liquid loses some of its transparency. Thus, the whole of the heat rays from a dark spiral, a red-hot spiral, and a hydrogen flame pass through the black solution of iodine in bisulphide of carbon, whilst from a gas flame only 96 per cent pass, and from the electric light only 90. Dr. Tyndall has found that the actual proportion of luminous to obscure rays emitted from white-hot

platinum may be thus expressed:—dividing the radiation into 24 equal parts, one of these parts is luminous and 23 obscure. When instead of the white-hot platinum the most brilliant portion of the flame of coal gas is employed, and the radiation is divided into 25 equal parts, one of these is found to be luminous and 24 obscure, whilst if the radiation from an electrical light excited by 40 cells is supposed to be divided into 10 equal parts, one of these parts is luminous and 9 obscure.

In a solution of iodine the experimentalist has now the means of almost perfectly detaching the obscure from the luminous heat rays of any source, and Dr. Tyndall has described numerous experiments in which brown paper was set on fire, gun-cotton exploded, and plates of tin and zinc fused, by placing these substances at a certain point in the air of a perfectly dark room, where the invisible rays of the electric light were concentrated. Dr. Tyndall has recounted one bold experiment on the amount of heat rays which the human eye could bear without injury. Converging the beam from the electric lamp by a glass lens, the opaque solution of iodine was placed before his open eye, and the eye was brought into the focus of the obscure rays, the heat was immediately unbearable; but it seemed that the unpleasant effect was mainly due to the action of the obscure rays upon the eyelids and other opaque parts round the eye. He therefore cut in a card an aperture, somewhat larger than the pupil, and allowed the concentrated calorific beam to enter the eye through this aperture; the sense of heat entirely disappeared. Not only were the rays thus received upon the retina incompetent to excite vision, but the optic nerves seemed unconscious of their existence even as heat. What the consequences would have been had Dr. Tyndall permitted the luminous third of the condensed beam to enter the eye, he is not prepared to say.

Mr. Barrett, assistant in the Physical Laboratory of the Royal Institution, has applied some of Dr. Tyndall's researches to the analysis of the human breath, and with very remarkable results. The mode of analysis is founded upon the calorific absorption exerted by the carbonic acid contained in the breath. With ordinary sources of heat, carbonic acid is probably the most feeble absorbent amongst the compound gases, but Dr. Tyndall has shown that where a carbonic oxide flame is used as the source of heat, carbonic acid instantly reverses its position, and exceeds all other gases in its heat-absorbing power. By employing a small carbonic oxide flame as the source of heat, and passing pure dry air into the experimental apparatus, no absorption whatever of heat was noticed, but common air gave an absorption of 15 per cent. of the total radiation; air, deprived of its aqueous vapour, but retaining its carbonic acid, gave 13·8 per cent. absorption; whilst air deprived of its carbonic acid, but retaining its aqueous vapour, gave only 6·4 per cent. By this method very small variations in the amount of carbonic acid present can be detected, and by working with air containing known quantities of carbonic acid, it was easy to construct a scale by comparison with which the percentage of carbonic acid in human breath could be ascertained with great accuracy. A series of such analyses are given, with the corresponding amounts of carbonic

acid found in some of the same portion of breath by chemical means. The accordance is very close. The fact revealed by the numerous tables which the author has given in his paper,* leaves no doubt that this method is a more delicate test for the presence of carbonic acid, than the present chemical means. As such it will be of service in many cases where chemical analysis would fail. If a simple and ready means of making a physical analysis of breath can be devised, this new method will undoubtedly be most useful in hospitals and elsewhere.

ELECTRICITY.—We have scarcely anything to chronicle this quarter in electrical science. M. Raoult has published some researches into the Thermal Phenomena of Voltameters, and measures of the quantities of heat absorbed in electro-chemical decompositions.† His experiments, relating to sulphate of copper and acidulated water, lead to the conclusion that a voltameter introduced into the current of a battery, weakens the electro-motive force, and thus destroys in the complete current a quantity of heat which is always greater than what is required for the decomposition effected. The excess varies according to circumstances; but in every case a secondary action takes place at the electrodes, whereby a quantity of heat is imparted to the voltameter equal to the excess of heat destroyed, and finally the sum of the various calorific effects of the voltameter is equal to the heat absorbed by the decomposition which goes on within it.

A valuable process for coating metals with firmly adherent and bright layers of other metals, has been communicated by M. Weil, to the Academy of Sciences.‡ The method consists in dipping the metal to be coated in a saline solution of the metal to be deposited, rendered distinctly alkaline with potash or soda, and mixed with some organic matter, such as tartaric acid or glycerine. At the same time it is necessary, in some cases, to set up a weak voltaic current, by keeping a piece of zinc or lead in contact with the metal. In this way the author obtains a firm layer of copper on iron and steel, and procures various and beautiful effects, according to the thickness of the copper deposited. Silver, nickel, and other metals, can be applied in the same way. The process, it will be seen, is susceptible of numerous applications. A curious fact mentioned is, that a clean surface of copper may be coated with zinc, by placing the two metals in contact in a solution of caustic, potash, or soda. In the cold the deposit of zinc takes place slowly, but at 100° C. it is effected rapidly.

* 'Phil. Mag.,' August, 1864.
† 'Phil. Mag.,' Dec. 1864. Supplementary number.
‡ 'Comptes Rendus,' Nov. 7, 1864.

X. ZOOLOGY AND ANIMAL PHYSIOLOGY.

(Including the Proceedings of the Zoological Society.)

The Copley Medal of the Royal Society has this year been awarded to Mr. Charles Darwin, for his important researches in Geology, Zoology, and Botanical Physiology, but we are sorry to add that his state of health would not allow of his receiving it in person; and one of the Royal Medals to Mr. J. Lockhart Clarke, F.R.S., for his researches on the intimate structure of the spinal cord and brain, and on the development of the spinal cord.

The Zoological results of the late expedition to Palestine under Mr. Tristram, consist of the collection of 130 specimens of mammals, 1,760 birds, 300 reptiles, and 100 fishes. Amongst the invertebrata the principal attention of the expedition was devoted to the terrestrial molluscs and diurnal lepidoptera, of each of which very fine series were obtained, as well as a considerable number of coleoptera and orthoptera. The species of birds new to science are but few, but many rare and little known forms are amongst them. We understand that the mammals of the collection will be named by Dr. Gray and Mr. Tomes, the reptiles by Dr. Günther, the insects by Mr. Bates, and the birds and molluscs by Mr. Tristram himself. The whole results of their investigations will ultimately be combined in a general work upon the Natural History of Palestine.

Professor de Filippi, of Turin, has lately delivered an address before that university upon the relation of man to the lower animals, adding his name to the daily increasing list of distinguished naturalists who hold opinions which correspond, more or less, with those put forward by Mr. Darwin. Without following the professor through the arguments by which he endeavours to show that "the idea of the species, like that of all the other elements of classification, is to be regarded as an arbitrary conception of the human mind, having no real existence in nature," he arrives at the result that "a physiological determination of the species is impossible, and henceforward we can only speak of systematic species, of species of convenience. What we are in the habit of denominating races or varieties are incipient species; what we call species are well-defined varieties, and especially varieties confirmed by a distant origin." With regard to the position of man in nature, even admitting, as he does, the probability of a simioid ancestry for our species, he thinks that we must not depend wholly upon the evidence to be obtained from a knowledge of the comparative anatomy of man and the apes. Man, he holds, is something more than an ape, with his legs elongated, his facial angle widened, the capacity of his cranium enlarged, and in it a few grammes more of that phosphuretted paste which is called brain. The place of man in nature must be determined not by the greater or less number of morphological characters subject to variation even within the narrow limits of the species, but by the comparison of the virtuality proper to man with that of animals. In the great advance of intellectual manifestations

displayed by all races of man when compared with even the highest apes, Filippi sees a line of demarcation between man and the lower animals, "a distinction which has rather more value than that unfortunate little *hippocampus minor* about which so much has been said,—a distinction which may be physically undeterminable, but which has more force than a whole series of sophisms." Naturalists generally, however, will not be found to follow the professor to his conclusions, when he says, "In fine, we shall not be guilty of an indiscretion if we force a little more the hand of this dispenser of honours (Zoology): let us seek boldly for the investiture of a kingdom; an internal voice tells us plainly enough that we deserve it."

The habits of the higher quadrumana, as observed in a state of nature, are too little known, and every contribution is valuable. Lieut.-Col. Tickell has contributed to the Asiatic Society some account of the Gibbon of Tennasserim (Hylobates Lar), found abundantly in the forests of that province. They ascend the hills to 3,500 feet, but not higher, and range in parties of from eight to twenty, of all ages. Their howls are heard for miles round, commencing at sunrise and becoming silent about 9 A.M., after which they are engaged in feeding on fruit, young leaves, buds and shoots, and *insects*, except for which they do not willingly come to the ground. When approached they sit close in thick tufts of foliage so as to be quite safe from the shot of the sportsman, and even if forced from their concealment, their extreme agility, swinging themselves from branch to branch with their long arms, shaking the boughs all round, and flinging themselves from prodigious heights into denser foliage, renders it extremely difficult to get a shot at them. It is, on the whole, a very gentle and peaceable animal. The female has one at a birth—two are as rare as human twins—and the young one sticks to its mother's body for about seven months. So entirely does it confine itself to its hands for locomotion about the trees, that it holds anything it may have to carry, by its feet. It drinks by scooping up the water by its long, narrow hand, thus conveying to the mouth a miserably small quantity at a time.

As exhibiting the rapid acclimatization and increase of some animals, it may be mentioned that M. Müller of Faroë, a member of the Danish Parliament, states that in 1854 or 1855, two pairs of hares were introduced into Stromoë, in Faroë, from Norway, and they have increased so rapidly that there are thousands now upon the island. One may shoot twenty in a day upon the hills, and it will be impossible to exterminate them. On the other hand, the same gentleman has several times tried to import Ptarmigan from Iceland, but hitherto without success. It appears that they cannot live more than two or three days, when captured. Eggs have proved unsuccessful also, the greater part having been sat upon.

The 'Courrier des Sciences' lately contained some curious and valuable statistics concerning the colours of the vipers caught at Fort Bourbon in Martinique. No less than 432 of these venomous snakes were killed during the year, the females being in the proportion of two to seven. Thirty-eight was the highest number of eggs

found, and nine the lowest; and it was observed that when one egg contains two young vipers, one of them is always yellow.

The latest idea that has been promulgated in connection with the cultivation of sea animals, is *turtle culture*. The artificial multiplication of the turtle, on the plan of securing the eggs and protecting the young, is advocated by M. Salles, who is connected with the French navy. To some extent turtle culture is already carried on in the Island of Ascension, so far at least as the protection of the eggs, and watching over the young, is concerned. M. Salles proposes, however, to do more—he thinks that to arrive quickly at a useful result it would be best to obtain a certain number of turtles from places where they are still abundant, and transport them to such parks or receptacles as might be established on the coast of France and Corsica, where at one time they were plentiful. Animals about to lay would be the best to secure for the proposed experiments. A vessel of sufficient dimensions should be in readiness to bring away the precious freight, and the captured animals, on arriving at their destination, should be deposited in a park chosen under the following considerations:—The formation of the sides to be an enclosure by means of an artificial barrier of moderate height, formed of stones, and perpendicular within, so as to prevent the escape of the turtles; but so constructed as to admit the sea, and at the same time allow of a large, sandy background for the deposition of the eggs, which are about the size of those laid by geese. As the turtles are herbivorous, the bottom of the park should be covered with sea-weeds and marine plants of all kinds, similar to those the animals are accustomed to find at home. A fine southern exposure ought to be chosen for the site of the park, in order to obtain as much of the sunshine as possible, heat being the one grand element in the hatching of the eggs.

Little has been done for pisciculture in this country, although so much has been said and written upon the subject; but in France the art has been revived in earnest. The moment it was ascertained that M. Rémy's discoveries in artificial spawning were capable of being carried out on the largest possible scale, that scale was at once resolved upon, and the Government of the country became responsible for its success. In Scotland, earnest endeavours have been made in the Tay, which have increased the rental at least 10 per cent.; and in Ireland, Mr. Ashworth, of the Galway fisheries, finds it as profitable and as easy to breed salmon as to rear sheep. His fisheries are a decided success, and if we except the cost of some extensive engineering operations in forming fish-passes to admit of a communication with the sea, the expense of his experiments has been trifling and the returns proportionately large. Mr. Ashworth put into his fisheries no less than a million and a half of salmon eggs in the course of two seasons.

The culture of the oyster also progresses favourably, both at home and abroad. An Act of Parliament was recently passed, enabling certain persons to take possession of a large portion of the foreshore at Herne Bay, for the purpose of breeding oysters; which Act, as might have been expected, has given great offence to those interested in ex-

isting companies. For there is already at Whitstable, close by, an opulent company of oyster breeders, who annually send a very large quantity of that favourite mollusc to Billingsgate. The fishing-ground of this company is extensive, occupying a space of 1,200 acres, and affording employment to about 2,000 persons. The operations of these dredgers approach very nearly the system of culture pursued in France, the difference being that the Whitstable men do not begin by saving the *spat*, that is, they do not breed their own oysters, but content themselves with buying brood-stock from their neighbours at Colchester and elsewhere; and the extent of their trade may be guessed from the fact of their having paid in the course of five years 150,000*l.* for brood. This company has a fleet of boats, which is valued at 20,000*l.*, while they estimate their lying stock of oysters as being worth at least 200,000*l.*; and the earnings of the freemen of the company have averaged about twenty-four shillings per week for the last fifteen years.

The quasi-parasitic mollusc *Stilifer*, of which one species, S. Turtoni, occurs upon our coasts, has given rise to some remarks by Mr. Jeffreys, who dredged living specimens in Shetland, upon Echini. Various views have previously been taken of the position and character of the animal, and it was at first supposed to be parasitic. This, however, has been disproved; for, although always found upon the tegumentary system of Echinoderms, the latter never appear to be otherwise than in perfect health and vigour; and Mr. Jeffreys supposes that the Stilifer feeds upon the excretions of the Echinoderms and not on animalcules. That there is some connection between the peculiar habitat of Stilifer (on the *upper* side of the Echinus) and its food, there can be no doubt, though there may be difficulty, in defining it. A similar case occurs in *Montacuta substriata*, which always adheres by the byssus to the *lower* side of Echinoids, or to the vertical spines near the mouth, where it probably avails itself of the currents excited by the ciliary action of the latter.

A Norwegian naturalist has recently obtained by means of the same instrument used by Captain M'Clintock and Dr. Wallich, between Cape North and Spitzbergen, living animals, from a depth of 8,400 feet, or more than a mile and a half. At that depth, where the temperature was only three-tenths of a degree Centigrade, or nearly the freezing point, were found living polypes, mussels, tunicates, annelids, and bright-coloured crustaceans. The same naturalist has found Ammonites (probably Jurassic), and leaves resembling those of the Palmetto (probably Miocene) at Spitzbergen.

Mr. C. A. Wilson, of Adelaide, a diligent Entomologist, having spent many years in investigating the insects of the colony, comes to the following conclusions with respect to the relative abundance of the various orders. Taking the Coleopterous insects (probably 5,000 in number) as represented by the number 20, the Hymenoptera would be represented by 11½, the Lepidoptera by 6½, the Diptera by 4½, the Hemiptera and Heteroptera by 2, the Orthoptera by 1, and the Neuroptera by ½. The remaining orders, Thysanoptera, Aphaniptera, &c.,

have as yet only yielded so few species (of Strepsiptera none has been found) that they are not here noticed. Of the above, the Hymenoptera are principally made up of the families Ichneumonidæ and Aphidæ—the Lepidoptera of the small moths—the Diptera, by the Muscidæ—the Homoptera, by the Cecropidæ, and the Orthoptera, by the Locustidæ. With the exception of the last, this seems much the same as in European countries.

M. Baudelot, struck with some experiments by M. Faivre, which had led the latter to suppose that the respiratory movements of insects have their origin in a special region of the nervous system, as in Mammalia, has conducted a series of experiments to test the matter, the result of which has been to prove that the metathoracic ganglion is *not* the prime mover of the respiratory motions, as was believed by Faivre. The experiments were made upon Dyticus, and the lava of Libellula, and he has proved that each abdominal ganglion supplies nerve-force, and co-operates as far as it can to the accomplishment of the respiratory action of the whole. And it is remarkable that, after the sections of the nervous cord, the isolated action of a ganglion appears to be by so much weaker when it is united to a smaller number of other ganglionic elements. When one takes into consideration the division in the rings of the body and of the abdomen of the Articulata, a division frequently so much in harmony with the nervous element—when one sees in Crustacea the breathing apparatus occupy so many varied positions, now at the level of the thorax, now of the abdomen, and see them receive nerves from so many different points—it was hardly possible to admit that insects have a special nervous centre for the functions of respiration.

Dimorphism, which has been found to occur so frequently both in animals and vegetables, has been observed in the gall insects (*Cynips*) by Mr. Walsh, who has recorded his observations before the Entomological Society of Philadelphia. Part of the gall produced males and females of *C. spongifica* (in June), while another part, of wholly similar general character, remain green till autumn, and in October and November produced another form of Cynips (*C. aciculata*), hitherto regarded as a distinct species, all the individuals of which are females, and although widely different in many characters, appears only to be a dimorphic condition of the first. These (*C. spongifica*) live only six or eight days, and Mr. Walsh suggests that the female *C. aciculata* generates galls which produce, by parthonogenesis, male *C. spongifica*, and that the females and males of the latter, coupling in June, oviposit in the same month in the young buds of the oak, eggs that remain dormant till the following spring, some of which then produce female *C. spongifica* in June, and some female *C. aciculata* in the autumn, or early in the following spring, and these last in their turn, generate male *C. spongifica* to appear in the following June. And he justifies his opinion by mentioning some of the analogies which have been observed in other hymenopterous insects.

M. de Quatrefages has communicated to the Académie des Sciences some remarks upon the geographical distribution of the Annelida, and

has indicated certain general laws which contrast strikingly with facts universally recognized in other groups. The swimming and tubicolous Annelids constitute in salt water the geographical term corresponding to the land and fresh water Lumbrici and Naïades. The marine class has representatives in all seas, and this cosmopolitism belongs not only to the large genera which best reproduce the general type, but also to the most exceptional sub-types. Hence the Annelidan Fauna does not present anything resembling zoological regions, such as have been demonstrated for most of the other classes of animals. While there is a tendency to diffusion in the genera, there is a counterbalancing tendency to restriction in the species, and none, or scarcely any of the latter, are common to two continents or hemispheres. Exceptions are probably due to marine currents, as the gulf streams, which he supposes may convey a species from the West Indian seas to the Indian Ocean. The corresponding geographical terms, therefore, must only be sought among *species*. Equality of organization is one of the most general laws of the group; it does not present the difference corresponding with the latitude which are found in the Crustacea, for example. And finally, the nature of the coast has the most influence upon the development of the Annelidan Fauna, granitic and schistose coasts being generally remarkably rich in species and individuals, while calcareous coasts are remarkably poor in both.

M. Hesse has described a remarkable apparatus in parasitic Crustacea, which he denominates the *frontal cord*, and which he supposes to be an important organ of conservation in these apparently helpless creatures. This cord is very flexible, especially in its middle part; hollow, cylindrical, and covered with a few hairs. By this cord the embryo is united with its mother, being attached by one extremity to the frontal margin of the young, and by the other to the body of the mother crustacea by a circular dilatation, and is sufficiently long and flexible to allow the young crustacea to act, to a certain extent, independently of its mother, and to apply itself to the fish, on which they live in common. These embryos, especially those attached to the *Trebiæ* and *Caligi*, which swim with tolerable rapidity, follow the evolutions of their mother, like a little boat towed along by a larger vessel; and M. Hesse is of opinion that the object of this apparatus is not the alimentation of the embryo, but to assist it while feeble and destitute of organs of adhesion, to maintain its position, and resist the action of the waves during the progression of the fish on which it is parasitic.

M. Sars has made some curious observations upon the persistence in the Scandinavian lakes of certain marine Entomostraca of the glacial epoch. Harpacticus chelifer was found in a fresh-water lake in the neighbourhood of Christiansund. In the Mjoesen lake, the largest in Norway, he discovered two species of Cythere, Mysis relicta (Lov.), and Gammarus cancelloides (Gerstfeldt); the two latter species were also found by Lovén in the Swedish lakes. In ponds of the environs of Christiania the amphipod, Pontoporeia affinis, was discovered. These species all inhabit the deepest parts of the water,

and live quite separate from the two fresh-water forms of crustacea. M. Sars considers the presence of these crustacea in the Scandinavian lakes to furnish evidence that, at the glacial epoch, the basin of the Baltic was in communication with either the Eastern or Western Arctic Ocean.

M. N. Lieberkühn, in a recent memoir upon the Spongillæ, describes some peculiar motory phenomena not heretofore observed in the Sponges. In some species the cutaneous pores are dispersed in great numbers over the whole surface of the Sponge, and usually lead into a large cavity belonging to the system of ingestion. The walls of the partitions bounding these cavities have vibratile apparatus. In others, the body is traversed in all directions by *trabeculæ* of different thicknesses, which are often supported upon the integument. Some of these are completely smooth in appearance, the strongest bearing vibratile apparatus. The pores of ingestion are not characteristic of the integument, as perfectly similar orifices are seen to originate in the membranous partitions of the interior of the body. The tubes of ejection are the seat of very peculiar movements, for he has seen the cells of the innermost layer gliding up the wall of the tube, and again descending. M. Lieberkühn has also demonstrated a fact which has only been suspected since the observations of Laurent, *viz.* the reproduction of sponges by spontaneous division. In individuals kept in vessels filled with spring-water he has seen the body contract, and emit here and there processes which soon became detached and glided over the vacant portions of the siliceous skeleton, and even upon the bottom of the vessel. This division appears only to take place in individuals which are nearly perishing, but the fragments set free continue to live, and in the course of a few weeks they have produced in their interior siliceous spicules and vibratile cilia.

That indefatigable and excellent microscopist, Dr. Beale, has been studying the structure of the sarcolemma and its relations to the muscular fibre on the one hand, and to the nerve-fibre and tracheæ on the other. This investment, as is known, is not universally found upon human striped muscle, and while the general opinion of Continental anatomists is that the nerve-fibres actually perforate the sarcolemma, and come in contact with the contractible tissue, Dr. Beale believes that this is an error arising from misinterpretation of the appearances observed. With regard to insects, the sarcolemma is seen delicately striated, arising not from the muscular striæ, but produced by the ramifications of fine branches of the tracheæ, which with nerves may be followed in considerable number to the sarcolemma. Under favourable circumstances, however, the highly elaborate arrangement of the nerve-fibres and tracheæ of the muscle may be observed. The fine trunk of the nerve, one of several terminating ones, is compound, and consists of a number of exceedingly delicate nerve-fibres, each one of these being composed of still finer fibres, which subdivides very freely, forming an elaborate network, which may be traced over every part of the sarcolemma. The arrangement of the tracheæ is equally elaborate, forming a network of extremely

minute tubes, also over every part of the sarcolemma. They frequently anastomose, and the finest branches are not to be seen by the aid of a magnifying power of 200 or 300 diameters. The delicate character of this investigation is the reason that their finest branches of nerves and tracheæ have never been observed before. The result of Dr. Beale's observations is, that the membranous sarcolemma of insect muscle is composed of very fine air-tubes and nerve-fibres imbedded in a transparent material, so incorporated with it as to form a part of its substance. This elaborate sarcolemma is developed with wonderful rapidity, the entire muscle being in some cases doubled in size in the course of two or three days.

The *use of dyes* for the examination of organic structures has been well illustrated by Dr. Beale's papers on the growth of tissues. He found that when tissues were stained with carmine, a permanent stain was acquired by certain portions only of the tissue, including those which are generally supposed not to have reached their ultimate grade of development, and excluding those which have evidently undergone a structural process. Graduated colour was thus given to tissues which probably were in a course of gradual transition into "formed matter." Iodine has long and deservedly been in repute as a test for starch and cellulose, but apart from this, it does not avail much as a dye. The compounds of aniline contain some which stain parts not coloured by carmine. Thus magenta, one of the most brilliant, has distinctive qualities, and selective staining power as great as that of carmine, and still more limited. Altogether unattracted by pure cellulose, it at once seizes those portions of "formed matter" which come under the head of "secondary layers." A dye for the structures left uncoloured by both magenta and carmine, is, however, still a desideratum. A satisfactory contrast of colour is not obtained by these two dyes; mauve, Hoffman's violet, aniline brown, picrate of aniline, and turmeric, all dye as magenta, but the purples alone approximate to the desired contrast. Aniline green produces results capricious and unsatisfactory, and the ordinary aniline blue of commerce proved under the hands of Mr. Walter Abbey, an instructive failure. The tissue came out magnificently coloured, but the colour was mechanically and partially distributed, and was entirely discharged by alcohol. The second blue effected the desired contrast, but at the expense of the carmine, instead of the magenta; and the blue substitute for carmine possessed intense and splendid colouring power, even more brilliant by artificial light than by daylight.

Mr. W. H. Griffiths describes the appearance of the so-called "contractile vesicle," in the Vorticellidæ, as somewhat differing from the received account. He attributes the appearance of contraction to the fact of the vesicle having been removed from the line of focus by the movements of the living animal, and objects therefore to the term *contractile*. With regard also to the processes from the vesicle supposed to have been observed by Lachmann, he believes that they were not branches of the vesicle, but only occasional interpositions of the cilia of the disc between the object and the microscope. If these ob-

servations are correct, this so-called *circulation* in the Vorticellidæ does not exist.

At the meeting of the German Association of Naturalists and Physicians, lately held at Giessen, Professor Schaffhausen, of Bonn, gave a lecture on Spontaneous Generation. To him spontaneous generation is the only wanting link in the chain of facts which prove the unity and unchangeability of nature. He has watched organic decomposing substances, and found they give rise to the lowest imaginable and smallest visible germs, which transform themselves into fungi and monads. All larger infusoria, he maintains, are only further stages of the development of these monads. The panspermic theory of Pasteur is to him an unproven hypothesis. And in discussing the beginning of life on the globe, he maintains that the first formation must have been capable of living on water and minerals, and that such a being is to the present day still formed spontaneously—the protococcus! A remarkable discussion was evoked by this extraordinary paper, opened by Vogt, of Geneva, with the inquiry after the circumstances under which protococci originated. Having been informed that pure water in a hermatically-sealed tube would, on standing, deposit these beings, he gained an easy victory by remarking that they must be a reign of organic beings for themselves, as capable of living on pure water, which neither plants nor animals could do. Remak, of Berlin, then said, in a somewhat depreciating manner, that it was only necessary to mention the names of Ehrenberg, Schwann, Helmholtz, &c., in order to show that spontaneous generation was an untenable hypothesis. This speaker was replied to by Vogt, who declaimed against this burking of inquiry by the quotation of authorities, and denied the panspermic theory as a fallacy. The discussion does not appear to have been carried on with that calm and philosophic soberness which should distinguish similar combats of opinion.

Proceedings of the Zoological Society.

The meetings for November transacted a considerable amount of business, in the form of papers upon subjects of Zoological interest, and often the results of observations made during travel in the past summer. Mr. Newton contributed notes on the Zoology of Spitzbergen, which he has been visiting; Mr. Flower, the results of his tour among the Museums of Holland and Belgium, in a paper on the Skeletons of Whales; and Dr. Tristram some Ornithological results of his late expedition to Palestine. He enumerated 322 species of birds as obtained in that country, of which 27 were peculiar to Palestine, and nine now described for the first time, but besides these, several others had not been before brought to England. Mr. Tristram's reptiles were remarked upon by Dr. Günther; but his most remarkable collection was the series of fishes from the Lake of Galilee, of which the greater part proved to be new to science. Amongst them were several species of the African genera Chromis and Hemichromis. Several im-

portant additions to the ever-growing collection in the Regent's Park, were announced, including a young female Chimpanzee, just received from West Africa; and it was stated that the head-keeper had returned safely from Calcutta, in July, with a valuable collection of animals, amongst which were a pair of Rhinoceroses, and several species of birds new to the collection.

Mr. Gould announced two new members of our Avi-fauna, the Emberiza pusilla of Pallas, and the continental Anthus campestris, both recently taken at Brighton. Prof. Huxley read a memoir upon the Structure of the Skull of Man, the Gorilla, the Chimpanzee, and the Orang-Outang, during the period of the first dentition, and based upon materials contained in the British Museum, the Royal College of Surgeons, and particularly upon the original specimens of Tyson's "Pigmy," in the Leeds Museum. A communication also upon the Crania and Dentition of Quadrumanous Animals, *viz.* the Lemuridæ, was made by M. St. George Mivart, also from similar sources; and from which examination he is induced to divide the Lemuridæ into four natural sub-families—the Indrisidæ, Lemurinæ, Nycticebinæ, and Galagininæ.

Dr. Gray and Dr. Sclater have also been active with communications—the latter upon new birds from India, Brazil, and Madagascar; and the former with a revision of the specimens of viverrine animals in the British Museum (which possess upwards of 80 out of the 102 species of the family known to the Zoologist), and other similar papers; also a description of the atlas and cervical vertebræ of a Right Whale, in the Sydney Museum, which appears to indicate the existence of a new form of this group, distinguished by the complete separation of the atlas from the other vertebræ, and called by Dr. Gray, Macleayius Australiensis.

SCIENCE IN BRITISH NORTH AMERICA.

The progress which Science is making in this part of the Colonial possessions of Britain is very satisfactory, and is due in a great degree to the exertions of the provincial learned societies, amongst which may be mentioned the Canadian Institute, meeting at Toronto, and publishing the 'Canadian Journal of Industry, Science, and Art;' the Natural History Society of Montreal, represented by the 'Canadian Naturalist and Geologist;' and the Nova Scotian Institute of Natural Science, which publishes its 'Transactions.' The subjects, which have received attention recently, may be arranged under the various branches of Science.

1. *Botany.*—Dr. George Lawson, of Dalhousie College, has laid before the Nova Scotian Institute a Synopsis of the Canadian Flora, embracing a list of all the flowering plants and ferns that have been observed in Canada, with their habitats and distribution, preceded by general remarks on the principal features of the Flora. In

the south-western peninsula of Canada, there is a luxuriant vegetation, largely composed of species which belong especially to the States, and including the tulip tree, the black walnut, the occidental plane, and several little Southern forms. Amongst the cultivated plants, are peaches, vines, tobacco, Indian corn, wheat, potatoes, kidney-beans, and pumpkins. The characteristic trees of Upper Canada are the beech, maples, several species of oak, ash, and birch, hickories, iron-wood, bluebark, butternut, pines, hackmatack, cedars (white and red), hemlock, balsam fir, poplars, and wild cherries. The true American flora, which is a continental one, is found best represented along the southern and south-western frontier of Canada; it decreases towards the Atlantic seaboard. There are many examples of it in Nova Scotia, but here there is a much greater preponderance of northern species than in corresponding latitudes in Canada. In Western Canada, many of the plants, common in Nova Scotia, are either entirely northern, or are confined to the great swamps, whose effect on the distribution of species is thus seen to be considerable. There are numerous examples of the Arctic or Scandinavian Flora in the northern and eastern parts of Canada, and still more in the Hudson's Bay territory. Allusion was made to the fact that there is a remarkable sameness in the plants associated with boulders in different parts of the country.

Chemistry.—Dr. E. J. Chapman, in a note read before the Canadian Institute, after referring to the discrepancies to be found in comparing various accounts of the blowpipe flame of iron wire, states that a bright green flame is given out by all the light-coloured and comparatively hard wires, whilst the soft and dark wires fuse much less readily, and cause no coloration. He found the cause to lie in the former containing a minute quantity of phosphorus. This is an important point, as iron-wire is often used in blowpipe experiments as a re-agent for phosphoric acid.

The mineral springs of Wilmot, N.S., have been analyzed by Professor How, who has given the results to the Nova Scotian Institute. These waters have obtained some reputation in the Province, and also in the United States; and are said to be remarkably efficacious in curing cutaneous eruptions. They occur in a district of the New Red Sandstone formation. One analysis gave the following results:—

Contents of the water of the smaller basin in 70,000 grains, or one imperial gallon.

	Grains.
Carbonate of lime	2·70
Carbonate of magnesia	0·37
Carbonate of iron	·14
Sulphate of lime	121·98
Sulphate of soda	8·35
Sulphate of magnesia	5·35
Chloride of potassium	1·10
Silica	0·55
Phosphoric acid	traces
Organic matter	traces
	141·04

The composition of the water in the larger basin closely resembled the other, differing only in containing more organic matter. The most noticeable feature is the large amount of sulphate of lime. In this respect the Spa spring of Windsor, Nova Scotia, is allied to those of Wilmot, as it contains 106·21 grains of sulphate of lime to the gallon. The professor remarks that analyses made on larger quantities than he had at command might reveal the presence of other ingredients.

Geology.—The last annual address to the Montreal Natural History Society, was given by Principal Dawson, president. After glancing at the scientific work of the Society, and expressing his admiration of the recently published Report of the Geological Survey of Canada, he proceeded to refer to a few points in Canadian Geology, to which the Report directs attention. The first was the discovery of fossils in the lower part of the Laurentian rocks, a discovery, he remarked, which will be "one of the brightest gems in the scientific crown of the Geological Survey of Canada." He referred to the subdivisions of the Laurentian rocks as forming a cycle of deposits similar to others found in the scale of formations. This subject deserves a more careful study as a means of settling the sequence of oscillations of land and water in connection with the succession of life. It may eventually aid in establishing more precise views of the dynamics of Geology and of the lapse of geological time.

He next referred to the supposed causes of the deposition of the boulder drift of Canada. The iceberg theory has lately been giving way before a reassertion of the doctrine that land-glaciers have been the principal agents in the distribution of the boulder-drift and in the erosions with which it was accompanied. He had been unable, however, to receive the latter theory, being convinced it was not in accordance with the facts he himself had observed in Nova Scotia and in Canada. The Report supported him in the belief that glaciers could scarcely have been the agents in the striation of Canadian rocks, the transport of boulders, or the excavation of lake-basins. Amongst the reasons for this opinion he gave the following :—

1. It is difficult to suppose a universal covering of ice in connection with a wide-spread continent in a temperate latitude. Even if these regions of North America were elevated into a table-land, its breadth would secure a sufficient summer heat to melt away the ice, except from high mountain peaks. There is no fact to support the alternative suppositions of the existence of immense mountain chains now disappeared, or an unexampled degree of cold from astronomical causes. He rejected Dr. Frankland's theory of a sea with a higher temperature, as inconsistent with the evidence of fossils, and as insufficient to account for the effects.

2. It seems physically impossible that an immense sheet of ice, such as supposed, could move over an uneven surface, striating it in directions uniform over vast areas, and often different from the present inclinations of the surface; whilst, if motionless, it could not produce striations.

3. The transport of boulders to great distances, and the lodgment

of them on hill tops, could not have been occasioned by glaciers. The supposed universal glacier could have had no cliffs from which to collect them, and it must have left them, after a transport of hundreds of miles, on points as high as their origin. Moreover, boulders are found in marine strata containing sea-shells, and these *must* have been borne by floating ice. The boulder clay contains marine Post-Pliocene shells in several places.

4. The Post-Pliocene deposits of Canada indicate a gradual elevation from a state of depression, while there is nothing but the boulder-clay to represent the previous subsidence, and nothing whatever to represent the supposed ice-period, except the scratches on the rock surfaces, which must have had the same cause as the boulder clay.

5. The land and fresh-water deposits underlying the boulder clay in various places, show that the sea at the period in question had much the temperature of the present arctic currents of the coasts, and that the land was not covered by ice.

The Report of the Survey throws light on the subject, by giving a valuable table of the striations: these are found to run in two principal directions nearly at right angles. Dr. Dawson had no hesitation in stating his belief, that the force causing one of these sets had acted in a direction from the ocean toward the interior, *against the slope of the St. Lawrence valley.* This is quite inconsistent with the glacier theory, but is eminently favourable to the idea of ocean drift, such as would be caused by a subsidence of the land—a fact proved by the Post Pliocene deposits. The facts thus ascertained account for the excavation of the American lake basins, which he compared to the pot holes cut by rivers. The other set of striations would be caused during a particular stage of elevation and depression, when the former outlet would be obstructed. He finally expressed his belief that many sea-beaches, gravel-ridges, and like margins, had been mistaken for morains.

Mr. William Gossip, Secretary to the Nova Scotian Institute, has described the rocks in the vicinity of Halifax, N.S. The report, which appears in the 'Transactions,' gives an account of the relation; between the metamorphosed stratified rocks and the intruded granites the former consist chiefly of slate and quartzite. In the Halifax peninsula there is no granite. The slaty rocks, wherever laid bare, are striated, and Mr. Gossip discusses the evidences of glacial action.

Mineralogy.—Professor How, in the same 'Transactions,' commences a series of notes on the economic mineralogy of Nova Scotia, in this part treating of the iron ores and iron manufacture of the province. The value of the provincial iron as compared with the best English, is thus shown:—

	£	s.
English pig iron (Staffordshire), average per ton -	4	0
Acadian - - - „ „ -	7	0
English bar iron (Staffordshire) „ „ -	9	0
Acadian - - - „ „ -	15	10

Compared with Swedish, their bars rank with the best qualities. There exist in the province three localities for Titaniferous iron ore.

Zoology.—In this branch it is satisfactory to find that our colonial friends are working earnestly towards a systematic account of the various groups of the animal kingdom, as represented in the respective provinces. It will be sufficient to mention the principal memoirs. The "Soricinæ of Nova Scotia" are described by Dr. J. Bernard Gilpin; the "Mollusca of the Bermudas," by Mr. J. M. Jones, F.L.S.; the "Butterflies of Halifax, N.S.," by Mr. Thomas Belt. Dr. Gilpin, in addition has a paper "On Introduced Species of Nova Scotia," with special reference to the breed of wild ponies, which, originally turned loose on Sable Island, have been left to themselves for 150 or 200 years. He compares them with the present wild stock now existing solely in Tartary, and he concludes that in the period mentioned these animals have returned, almost literally, to the habits of the old primal stock, never yet subdued by man.

REVIEWS.

ENTOZOA.*

THE recent researches of Steenstrup, Küchenmeister, Von Siebold, and others on the Continent, and of Allen Thomson, Rainey, Busk, and the author of the present volume in this country, have thrown an interest around the study of Entozoa, which has scarcely been surpassed in any other department of zoological inquiry. Although these researches have great practical value, they excited but comparatively little interest in the medical profession, till the publication of Dr. Lankester's translation of Küchenmeister's large work on 'Human Parasites,' and Mr. Huxley's translation of Von Siebold's work on 'Parasitic Worms,' by the Old Sydenham Society. Since that time no systematic work in the English language has appeared, except Dr. W. Smith's work on 'Human Entozoa,' which is professedly an adaptation of a French work by M. Devaine. Numerous papers have, however, been published in English and foreign periodicals, and in the books on practical medicine, by Dr. Watson and Dr. Aikin; and in Mr. Hulme's translation of Moquin-Tandon's 'Medical Zoology,' brief accounts of our present knowledge of the Entozoa inhabiting the human body have appeared. Under these circumstances, it seemed very desirable that all that was known on this interesting and important branch of natural history and pathological inquiry should be brought together, and no one could have been found more competent to the task than the author of the present volume. We must also congratulate Dr. Cobbold and his publishers, that they appear not to have taken up this subject as a mere matter of business, but as a labour of love. Amongst recently-published books on natural history, we do not recollect to have seen one in which all the requirements of paper, printing, and illustration have been so carefully attended to, and we are almost inclined to be jealous that inquiries into other departments of natural history have not fallen into equally generous hands. We would especially speak of the plates and woodcuts as being all that could possibly be wished for the identification of specimens, and the illustration of the text.

Dr. Cobbold divides his work into three parts. The first is devoted to the Systematic, the second to the Special, and the third to Spurious Helminthology. In the first part our author discusses the propriety of placing the various forms of parasitic worms in the same group. There is, no doubt, sufficient diversity in their forms to justify the assigning of these worms, in a purely zoological classification, to very different groups; but we are inclined to agree with Dr. Cobbold,

* 'Entozoa: an Introduction to the Study of Helminthology, with reference more particularly to the Internal Parasites of Man.' By T. Spencer Cobbold, M.D., F.R.S. London: Groombridge & Sons.

that their community of habit and similar life-history, combined with the great practical advantage of studying them together as parasites offensive and injurious to the human body, justify their union.

The following is Dr. Cobbold's proposed scheme of classification :—

Class Helmintha	Sub-class I. Sterelmintha	Ord. 1. Turbellaria	Entozoa,	
		Ord. 2. Trematoda		
	Sub-class II. Cælelmintha	Ord. 3. Nematoda		
	Sub-class III. Anenterelmintha	Ord. 4. Acanthocephala		
		Ord. 5. Cestoda.		

This is a good practical classification, and by placing the Thorn-headed worms (*Acanthocephala*), and Tape-worms (*Cestoda*), in a separate sub-class, the other two sub-classes have been undoubtedly strengthened.

The propriety also of placing the Turbellarian worms—Planaria, and Nemertes, with their congeners, near to the Trematode worms, will at once be apparent to all those who have studied these comparatively neglected organisms.

After having settled the questions that may arise out of his general classification, Dr. Cobbold proceeds to illustrate each of his orders. In this part of his work he takes up some particular species, and gives an account of its anatomy, development, habits, and distribution. In the description of the Turbellaria, reference is made to the curious fact of the extensibility of the species of Nemertes. One of these, *N. Borlasii*, is said to be capable of stretching itself to fully eight times the length of the body whilst at rest, so that the animal, which is ordinarily four or five feet in length, is capable of assuming a length of forty or fifty feet. These worms are, however, not entozoa.

The second order, Trematoda, are true entozoa, and are commonly known by the name of flukes. This order is composed of five families, which are mostly characterized by the number of openings upon their flat bodies, which have given the family its name. These creatures are found in the bodies of men, mammals, birds, and fishes. Dr. Cobbold has described several species. In a recent investigation of the number of species described, he says, "I recognized 344 species of flukes, 126 of these belonging to fishes, 47 to reptiles, 108 to birds, 58 to mammals, and 5 to invertebrata." This did not include those forms which are found attached to the skin of animals, which would probably raise the number to 400 species. It is in this family that Van Beneden originally observed the curious phenomena of "nursing;" but which really consists of the offspring of the original parent being capable, at certain stages of their growth, of producing new individuals. This offspring, the larval "great-grand-children," are the previously known *Cercariæ*, which ultimately become transformed into a form similar to the first parent. Dr. Cobbold gives an interesting account of his observations on *Gyrodactylus elegans*, one of the most highly developed of the Trematodes, and which he obtained from sticklebacks, caught in the Serpentine.

The Nematode, or thread-like worms, come next. These are arranged in eight families. First among them is a group familiar

enough to the young naturalist, but hardly entozoa. These are the Anguillulidæ. Who that has examined a drop of dirty water under the microscope, has not been puzzled with the appearance of a number of twisting, twirling, eel-like bodies, which no author on the microscope condescends to describe? To this family Dr. Cobbold refers vinegar-eels and paste-eels, and says, very truly, of them, their "intimate organization and course of developement is not yet well understood." Why does not some fancy microscopist take these small fish under his especial care, and let the world have the result of his labours? They would be very interesting.

Next to these small eels come the hair-worms, the Gordiidæ. In this family the tendency of the ova to develop themselves in the body of living animals is seen. It is more or less the characteristic of the whole of the entozoa to travel, and take up their abode in various localities, now inside and now away from a living animal. In this group of animals fragmentary observations have been made, which seem to show that great variety takes place in the method of their wandering. The Oxyuridæ or true thread-worms, are the next family. They are represented by a species *Oxyuris vermicularis*, only too well known as an occupant of the human body. The fact of their "wandering" has not been well made out, though suspected by Küchenmeister and others. They are easily distinguished by their minute size from the next family, the Filaridæ, which include the whip-worm (*Trichocephalus dispar*), and the round-worm (*Ascaris lumbricoides*), so commonly found in the human intestines. Members of this family are found very generally in the intestines of the higher animals. They gradually pass into the family *Strongylidæ*. One of the best known forms of this group is *Sclerostoma Synganus*, a worm which attacks birds, and which is known to infest poultry, producing a disease familiarly known as the "gapes." It has been found in the trachea of the turkey, domestic fowl, pheasant, partridge, stork, magpie, common woodpecker, starling, and swift. It would be found in other birds, probably, were it looked for. Other forms of this family have been found to infest the common porpoise and the narwhal. These creatures have been carefully dissected and studied by Mr. Busk, and two plates of their structure, from his pencil, illustrate the text.

The last two orders belonging to Dr. Cobbold's new sub-class Anenterelmintha, are the Acanthocephala and Cestoda. The first of these orders, called also from their peculiar structure thorn-headed worms, are found infesting almost all classes of vertebrate animals, but up to the present time none have been discovered in the human body. They are especially abundant in birds and fishes, and are found anchoring themselves in the mucous membranes of the intestines of these animals, by means of the retractile thorns, or proboscis, which they bear on their heads. Upwards of one hundred species of these worms have been described. The one which Dr. Cobbold has chosen as the type for his descriptions is the *Echinorhyncus anthuris* of Dujardin, a little worm a quarter of an inch in length, found in the intestines of the lesser water-newt (*Lissotriton punctatus*). The development of these animals has been recently observed by Leuchart

in the *Echinorhynchus proteus*, a species known to inhabit the trout. Leuchart obtained the ova of this species, and having introduced them into some water containing the water-flea (*Gammarus Pulex*), he found they were readily swallowed by these animals. In a few days the young embryoes were hatched, and found boring their way through the intestinal walls into the general cavity of the body. Here they passed through changes which required only about a week to complete their perfect development in the intestine of their ultimate host.

The Cestoda, of which the common tape-worm may be taken as the type, are the most highly-developed forms of Helminths. They embrace the various forms of cystic worms of older writers, which are now known to be but larval stages in the growth of the perfect worms. Within the last few years, the life-history of these creatures has been thoroughly well made out, both by observation and experiment. These worms pass but a short period of their existence out of the bodies of their host; but in all cases they appear in various stages of their growth to occupy at least two animals of different species. The tape-worms affecting man, dogs, and cats, have been most intimately studied. During growth, they present the following phases of development :—

1. The egg.—This is developed in the "joints," or "proglottides," as they are called, of the mature animal. These pass away from the host, and the eggs escape. In this state they pass into water, or on to soil or plants, which enter the stomach and intestines of another animal. The egg appears to be favoured in its development by the gastric juice of the animal which has swallowed, and gives rise to the next stage.

2. The six-hooked embryo.—Round in form, it has the hooks placed in such a way as to enable it to pass easily through the walls of the intestines, into the circuit of the blood, when, according to its peculiar nature, it is conveyed to the liver, the brain, or the muscles of the swallowing animal. Having obtained a resting-place, it is now developed into a cystic worm—the *Cœnurus cerebralis* of the sheep, the *Cysticercus cellulosæ* of the pig, or should it become abortive, the *hydatid* of the pathologist.

3. The cyst contains in its interior the "scolex," or "head," of the perfected worm. Should this head be now swallowed by a second animal, it seizes hold of the mucous membrane of the intestines, and in the course of a few days becomes developed into the "colonial," or tape-worm, condition, which constitutes—

4. The perfected worm, or "strobila," the perfected joints of which are the proglottides, which once more produce the eggs.

Such is the life-history of these creatures, which have been more or less clearly made out in above 200 species of them. The interest of this group of animals culminates in the fact that about ten species, either in their cystic or perfect stages, affect the human being. In their cystic stages they are more dangerous to the human being than in their perfect stage. In the former they inhabit organs, as the brain, the liver, and the kidneys, from whence they cannot be easily expelled, whereas in the latter, they occupy the free surface of the

intestine, from which, by appropriate remedies, they can be easily dislodged.

We shall not attempt to follow Dr. Cobbold into the second department of his work, in which he treats of those helminths which are peculiar to the human body. The following list of human entozoa, as the most complete hitherto published, may, however, prove of interest to many of our readers:—

TREMATODA.

Fasciola hepatica	Linnæus	Rare.
Distoma lanceolatum	Mehlis	Very rare.
D. Ophthalmobium	Diesing	One case.
D. Buskii	Lankester	One case.
D. heterophyes	Siebold	Two cases.
Bilhazia hæmatobia	Cobbold	Common in Egypt.
Tetrostoma renale	Della Chiaje	One case.
Hexathyridium pinguicula	Treutler	One case.
H. venarum	Treutler	Four cases.

NEMATODA.

Ascaris lumbricoides	Linnæus	Common.
A. mystax	Rudolphi	Rare.
Trichocephalus dispar	Rudolphi	Very common.
Filaria lentis	Diesing	Very rare.
F. trachealis	Cobbold	One case.
Trichina spiralis	Owen	Common.
Strongylus bronchialis	Cobbold	Rare.
Eustrongylus gigas	Diesing	Very rare.
Sclerostoma duodenale	Cobbold	Common.
Oxyuris vermicularis	Bremser	Very common.
Dracunculus medinensis	Cobbold	Common.
D. Loa	Cobbold	Common in Africa.

CESTODA.

Tænia solium	Linnæus	Very common.
T. mediocanellata	Küchenmeister	Common.
T. acanthonias	Weinland	One case.
T. flavopuncta	Weinland	One case.
T. nana	Von Siebold	Rare.
T. elliptica	Batsch	One case
T. marginata	Batsch	In cystic stage rare.
T. echinococcus	Von Siebold	In cystic stage common.
Bothriocephalus latus	Brenna	Rare in England.
B. caudatus	Leuchart	One case.

We have endeavoured to indicate the comparative frequency of the occurrence of these worms in the human body. The number of single and very rare cases shows that there is much to be done by subsequent observers, and that this field of observation invites further investigation, which will be rewarded by its practical utility. We must now close our notice of Dr. Cobbold's book, by recommending it to the study of all who are engaged in the investigation of the Entozoa.

THE LAWS OF HEALTH.*

It is not because we are behindhand in England with regard to public health that so few works in our language have been devoted to the subject. In fact, there are few countries in Europe in which so large a mass of matter exists on this subject. Our sanitary activity takes date from the invasion of cholera in 1831, since which time Parliamentary inquiries have resulted in a number of Blue Books containing abundant facts on the subject of public health. Our Legislature has been by no means behindhand. A Board of Health has been established, and, although not now existing, has left a permanent institution on our Statute Books. The Nuisances Removal Act, the Local Government Act, the Metropolitan Management Act, the Vaccination Act, the Army Sanitary Commission, the Burial Board, the Children's Employment Commission, the Lodging House Act, the Bakehouse Act, the Adulteration of Food Act, and a number of other Acts and institutions are so many proofs of our sanitary activity and the regard we pay to public health. To be sure, our legislation has been rather fragmentary, but that is the character of all our legislation, and our Legislators seem to glory in the fact. But during all this time, we have had no systematic teaching of Hygiene. In every University on the Continent the subject has been considered of sufficient importance to demand teaching from a special Chair; hence, men have been trained to teach and learn the first principles of Sanitary Science, and manuals and text-books have been published for the benefit of students and the public. It was a grand move in the right direction when the Government determined to give to the ill-educated youths who were induced to enter the medical service of the army, the opportunity of studying, more especially the subjects which would demand their attention as surgeons in military service. The Medical School which was first opened at Chatham, and afterwards transferred to Netley, was made to comprise a Chair of Military Hygiene, and to this Chair Dr. Edmund Parkes was appointed. A happier selection could not have been made. Dr. Parkes is not a man to sit down quietly to enjoy a good appointment. Having now delivered several courses of lectures in his new Chair, he has given to the public in this volume the subject of his teachings. Hence, we get for the first time a comprehensive work on Public Health.

Although this volume is written from the military point of view, and is prepared especially for use in the medical service of the army, it nevertheless contains the first principles of all sanitary action, and is essentially a work on general hygiene. We shall not attempt here to criticize a work which, after attentive perusal, we regard as equal to any that have appeared either in France or Germany on this subject; and which in every department gives indications of the author's comprehension and laborious inquiries. We almost regret that the

* 'A Manual of Practical Hygiene, prepared especially for Use in the Medical Service of the Army.' By Edmund A. Parkes, M.D. London: Churchill & Sons.

author has been compelled to press his large knowledge of sanitary science into the service of the army, and that he was not induced to call it a book on general public health, as, after all, the necessities of sanitary rules for the soldier, independent of the civilian, are of very small account, and might have been comprehended in a very few pages. In fact, nearly 500 out of the 600 pages, of which the book consists, is occupied with the discussion of first principles, which apply to sailors and artisans, to merchants and beggars, as well as to soldiers. The general subject of the work is treated under the heads, Water, Air, Food, Soil, Habitation, Clothes, Climate, and Disease.

The first subject treated is water, a point of first-rate importance, no doubt, both in relation to the health of soldiers and the community at large. Yet it is a strange fact that scarcely anything has been so much neglected by the armies and cities of Europe. On this point our civilization lags immensely behind that of the ancient Romans, and their ruined aqueducts are a silent reproach to modern civilization. Much of the disease of our army in India, more especially cholera, can be traced to the utter disregard of water supply, and the same may be said with regard to the visitation of cholera in the towns and villages of Great Britain. So palpably was this the case, that London, Manchester, Liverpool, Glasgow, and other great cities, have gone to an enormous expense to obtain pure water for their inhabitants. At the same time there is great popular ignorance on this subject. Although it has been shown over and over again that the surface wells in large towns are almost always contaminated with impurities, yet these wells are had recourse to, and exist in, almost every town in the kingdom. Strange to say, these wells and pumps when attacked are almost always sure to have their medical apologists, and the knowledge of one set of medical men is made to oppose the other. At the present moment it is a great defect in our medical education, that there is no teaching on the subject of preventive medicine, and young men are turned out of our medical schools as ignorant of sanitary science, as their less instructed neighbours.

Dr. Parkes examines the whole question of water supply with great ability. He first considers the quantity necessary for men to drink in health, and gives us an approximation to the average quantity required in twenty-four hours, as half an ounce to every pound which the body weighs. Thus a man weighing 150lbs. would require 75 ounces of water in the day. This, we believe, is a good approximation. Of course the quantity will vary according to the activity of the skin in getting rid of water, which again depends on occupation, climate, and the temperature of the external air. The quantity required for all the washing and other purposes of a residence depends very much on the habits of a people. In 14 English towns of second-rate magnitude, 24 gallons a day are supplied to each inhabitant. In Manchester, 20 gallons; in Liverpool, 30 gallons; in London, 50 gallons; in New York, 300 gallons. Ancient Imperial Rome received from 300 to 340 gallons per head daily.

Dr Parkes has a capital chapter on the examination of water, so that any person with a knowledge of how to use a microscope, and the

first principles of chemistry, can easily determine what are the properties of any particular water, and whether it will be fit to drink or not. A ready way of detecting the amount of organic matter, and one that is recommended by Dr. Parkes, is by the addition of permanganate of potash. The amount of permanganate destroyed is the measure of the organic matter in the water. This is even made obvious to the eye without any weighing, where a series of waters have to be examined; the permanganate losing its beautiful pink colour when decomposed. All ready methods of detecting the composition of water are of great importance to an army on the march. It is not always that clear waters are to be trusted. The notorious pump in Broad Street, Golden Square, London, yielded water perfectly clear, and was the most popular pump in the district, yet its waters killed 500 people in the three first nights of September, 1854. The cause of this dire calamity was the communication of a broken drain from a cesspool with this well; but the water at the time it was drunk gave no signs of this contamination. After such a dreadful accident as this, in a district otherwise well supplied with water by public companies, it would have been thought that this and the other surface well-pumps would have been closed. But no, there it still stands as a memorial of the difficulty of instilling into the public mind, the necessity of obeying sanitary laws, although enforced by such awful examples as this.

From water we come to air. Dr. Parkes has treated this subject in the same comprehensive and exhaustive manner as the other. Air is more important to life than water. Impure air is a source of more disease than impure water, at the same time its dangerous effects are slower in their action. The impurities of water either produce sudden disease, or their effects pass off before the next dose is taken; but the effects of impure air are cumulative, as well as sudden and disastrous. Typhus, smallpox, scarlet fever, measles, are all born of impurity of the air, as well as scrofula, consumption, and a host of diseases connected with the existence of the state of the system in which they come on. The importance of this subject is only beginning to attract attention, and amongst the most intelligent classes there is only a glimmering consciousness that impure air may become a source of disease. In our great towns, and in the majority of our populations, no knowledge of the practical value of this question seems to exist. Masses of men, women, and children are huddled together in dwelling-houses, whilst our workshops, and shops lighted with gas, are crowded with work-people, and the result is a frightful mortality. But neither the costliness of this neglect in an economical, nor its wickedness in a moral, point of view, seems to produce any impression. London, with its teeming population, thus loses thousands of lives annually, and yet is the seat of a legislation, which for weeks debates on the Schleswig Holstein question, and has a press which deplores the fratricidal war in America, but has no measures of relief for those who die for want of fresh air, nor any words of compassion for the slain innocents, and the dying men and women of their own city.

In his opening chapter on this subject, Dr. Parkes discusses the

question of the quantity of fresh air required for healthy existence. After giving the result of a variety of experiments in the quantity of carbonic acid expired, and of oxygen consumed, by a human being in twenty-four hours, he comes to the conclusion that in order to render the products of expiration and transpiration uninjurious, a human being should be supplied with 2,000 cubic feet of fresh air every hour. In order that anyone may see how far short of a proper standard of pure air they are breathing, they have only to calculate whether the room they sit, sleep, or do their business in, will allow of the egress of 2,000 cubic feet of bad air, and the ingress of the same quantity of fresh air for every person occupying them; if not, they will suffer. This is one of the great problems to be solved, in order to secure a healthy existence. One great difficulty that meets us in every direction is the necessity of warmth. We try by our feelings to measure the necessity of warmth against fresh air, and as cold is much more easily appreciated than bad air, we secure warmth at a frightful expense.

A great evil which has been recently added to our civilization, is the use of gas. Its economy, its brilliancy, has led to its use in almost every household, and there can be no doubt that its use has increased our dangers from impure air fivefold. Fortunately its use has not extended to the lowest classes, or its effects would be frightful. The cause of the deadly influence of gas is, that each gas-light consumes as much oxygen, and gives out as much carbonic acid, as five human beings. It is thus that gas has given the results of overcrowding to houses, that previous to its use were free from any such effects. Nothing but the universal adoption of a system of carrying directly out of our rooms, by some means or another, the products of the combustion of these deadly consumers of oxygen, can prevent their disastrous effects on the health of the community.

Air, however, is not alone rendered impure by the respiration of human beings and combustion, but by various effluvia. These are organic and inorganic. The organic are *living*, as microscopic plants and animals, and the poisonous molecules of contagious diseases, as typhus, typhoid, and scarlet fever; and *dead*, as the poisonous molecules given off from decomposing animal and vegetable matters. All these are treated of by Dr. Parkes, and valuable practical directions are given for the ventilation of rooms, and for the getting rid of poisons in the air.

We cannot, however, follow Dr. Parkes through the remainder of his book. The space given to the consideration of food is very large, and is, perhaps, the only part of the work in which the author has been fully anticipated by other writers. At the same time we recommend the disciples of Banting to turn to Dr. Parkes's volume if they want to see the dangers into which they are likely to fall, and the absurdity of the statement made by Mr. Banting himself, that the subject of diet was not understood, and had not been studied by medical men.

The chapter on dress is well worth attention at the present day, when our Volunteers are likely to set the fashion of how a man ought

to dress to secure health and strength. Everyone must admire Dr. Parkes for the unhesitating manner in which he denounces the absurdities of many of our articles of military clothing. Our soldiers have been everywhere, and in every direction sacrificed, from the fact that the men in command have been ignorant of the first principles of Military Hygiene. It is to be hoped that after the publication of this work we shall no more be called upon to read the sickening details of a second Military Commission, but that the authorities at the Horse Guards, animated by the noble spirit of the late Lord Herbert, will see that the best way to secure courageous and intrepid soldiers is to treat them as men having minds and bodies regulated by Divine laws, which if broken must lead to their natural punishment, disease and death.

HUMAN PHYSIOLOGY.*

The fact that so large a work as this has, in the course of a few years, reached the sixth edition, is a sufficient guarantee of the utility and value of its contents. Whilst we have several other works of equal, or nearly equal, magnitude, and going over precisely the same field of research, Dr. Carpenter's book is undoubtedly unrivalled in point of style and arrangement. Whilst less of an original observer than some other writers on Systematic Physiology, no one has more firmly grasped the great principles of Biological Science, nor shown himself more capable of conveying in thoughtful language the result of the labours of others. In every new edition also the author has kept pace with the progress of his Science, a labour of no mean order, when it is considered how rapidly the various branches of Physiological inquiry have progressed. In reading this work we cannot but feel that the author must have made it a labour of love; that higher thoughts have inspired him than either the profit or the reputation of the work; he must have felt that he had a mission to fulfil, and that was, the instructing his countrymen in the elements of a science whose principles are truly one of the keys to human happiness. It must have been with a pang of regret that he felt himself called upon to obtain the assistance of younger hands to enable him to complete his sixth edition. We do not think that it redounds to the credit of England that she has nothing with which to reward one of her most distinguished Physiologists, but a post that compels him to give up his physiological studies. It is in consequence of this want of any thing like national encouragement of the culture of the Natural Sciences, that we are obliged to yield the palm of physiological discovery to the Continent, and to see our most promising men of Science

* 'Principles of Human Physiology.' By William B. Carpenter, F.R.S., F.L.S., F.G.S. Sixth edition. Edited by Henry Power, M.B. Lond. London: John Churchill & Sons.

driven into the ranks of mere mercantile or professional pursuits, for the purpose of obtaining the means of subsistence for themselves and their families.

The present edition differs considerably from the last, both in the omission of old valuable matter, as well as in the addition of new. Thus, the chapter "On the Functions of the Cerebrum," which appeared in the two last editions, is omitted in this. To students of Psychology, this would be really a loss, much to be regretted, had we not the expression of a hope on the part of Dr. Carpenter, that he may at some future time be able to expand this outline into a Manual. We have always regarded Dr. Carpenter's work as particularly valuable from the masterly way in which he has developed the details of the structure and functions of the nervous system, and we are sure that every student of the powers and operations of the mind would rejoice to have such a manual from his hands.

The new matter in this work forms a very conspicuous feature, and is very creditable to the industry and intelligence of Dr. Power. In the chapter on Food, considerable additions have been made to the section treating of the saliva; and the recent experiments of Bernard, Adrian, and Eckard on the influence of the nervous system on this secretion have been given. The experiments of Brucke and Meisner on the gastric acid, and the results of the action of this fluid on fibrin and albumen, are introduced. New matter has also been given with regard to the action of the bile and the pancreatic juice. A considerable addition has been made to the section on absorption, and an account of the researches of Graham and others on Osmosis is given. In that portion of the work devoted to the consideration of the blood, much of the old chemical matter has been omitted, and a fuller account has been given of the structure of the blood-corpuscles, and the forms of blood-crystals as seen under the microscope. A considerable portion of the chapters on circulation and respiration has been re-written. There is a very interesting chapter by the editor, on the "Balance of the Vital Economy," in which he has gone into considerable details with regard to what may be called the debtor and creditor account of the system. In this chapter the most recent researches of Bischoff, Voit, and Ranke, have been made use of, and no one can rise from its perusal without feeling that such investigations are bringing us nearer to an explanation of the phenomena of life, which cannot fail to be of great practical value.

There are also considerable additions to the chapters on the functions of the liver, kidneys, and nervous system. The chapter on muscular tissue has been considerably enlarged, whilst the subject of generation and development has been more fully described and illustrated. In fact, everything has been done for this edition which conscientious editing could do. Nor has the publisher spared in his part. Several new woodcuts have been added, and executed in a style that enhances considerably the value of the volume to the student. For the non-medical reader we regard Dr. Carpenter's 'Principles of Physiology' as the most readable book on the subject in our language, and we should be glad if any recommendation of ours would induce

men not intending to practise the medical art to study its pages. It is a mistake to suppose that the laws of life are alone of practical interest to the medical practitioner. There is no man that has a body to preserve from disease and save from a premature death that is not interested in the study of the principles of Human Physiology.

MAN AND NATURE.*

THE influence of man, whether civilized or uncivilized, on the face of nature, is a subject that has not failed to attract the attention of physical geographers; but the facts of history, though often alluded to, have not yet been collected and brought into a single volume before the publication of the present work. Judging from the useful list of references at the commencement, the author has laboured very conscientiously; and the result, although rather heavy reading, is an interesting collection of valuable records.

Man produces effects on the earth's surface, both directly and indirectly, and these effects are sometimes conservative, but for the most part destructive, tending to derange and interfere with the balance of nature. That man's influence, especially in a civilized state, is exceedingly potent, there can be no doubt; and it is shown in a very striking manner in relation to the organic world. Thus millions of wild cattle are wantonly destroyed in South America, for the sake of their hides and horns; tens of thousands of elephants, for their tusks; and thousands of ostriches, for their wing feathers. And, far above and beyond all these destructions, there is the cutting down of timber, which has been carried to so great an extent in Europe, and even in North America, as to interfere greatly with climate, and change the conditions of the atmosphere. There can be no doubt that, in South-Eastern Europe, where forests no longer remain, the once well-wooded and humid hills have been turned to ridges of hard rock, without a particle of soil. Even within the historic period, these naked rocks were, to a large extent, clothed with forests. The change that has taken place is due to the continued residence of man, and it is one of which the magnitude and importance are by no means duly considered.

The removal of woods and forests seems to be one of the first results of civilization. But the effect of this removal is rapid and cumulative, and seems generally injurious. First, the earth, deprived of its green and living clothing, radiates heat much more rapidly under a clear sky at night, and receives much more heat from the sun by day. The climate thus becomes excessive. Bleak winds sweep over the cleared surface; and when rain falls, it is rapidly carried off, instead of being long retained on the surface, and carries with it

* 'Man and Nature; or, Physical Geography as modified by Human Action.' By George P. Marsh. London: Sampson Low, Son, and Marston, 1864. 8vo. pp. 560.

some proportion of the soil and rock. After such a change, rivulets, once peaceable and regular, become torrents in winter, and dry water-courses in summer; the uplands are worn away, and the beds of water-courses and lakes raised. In the same way, channels of rivers become unnavigable, estuaries are shoaled up, and sand-bars accumulated. The earth grows less productive, soil is lost, and bare rock alone remains.

Although, no doubt, there are many exceptions to this gloomy statement, yet no one can have visited the ancient seats of civilization in Europe without recognizing its general truth. Why civilization in India, China, and Japan—probably very old—has not succeeded in effecting such important changes, is partly explained by the peculiar nature of the cultivation, which carefully produces by mechanical and artificial means the results that are obtained by nature from forests. It is probable, however, that the maximum change has long been produced in those countries.

Illustrations of the result of the removal of forests are given by Mr. Marsh in great number and variety. At the surface, this result is barrenness, such as is seen in Greece, and the Greek Islands in Asia Minor, on the Karst, and in other lower and more level portions of the Alps; and also in the Central and Southern Apennines. Another surface result is the increase in frequency and violence of river floods. Below the surface the springs are equally affected: they are more irregular when the natural covering of forest has been removed: their amount also is smaller. It is a matter of familiar observation, that whenever springs have been measured, they have been found to be diminishing in their supply. Many observations to this effect have been recorded in Europe, and some even in America. A few of these are strengthened by our knowing the counter-result when the forests have been again allowed to grow.

There is good evidence that Europe generally has undergone great changes of physical geography within the last eighteen centuries. Thus the river Seine, now variable to the extent of thirty feet, was in the fourth century a steady flowing river, free from floods. Even the deltas at the mouths of some rivers seem to have commenced only when, for some reason, forests that once covered the country were destroyed. The Dinance, now one of the most dangerous streams in Europe, owing to its constant and fierce torrents, was a navigable stream in the time of the Romans. In torrents this stream has brought down and deposited in its course, or at its mouth, much of the best soil of the Alps. The country through which it passes is being depopulated. These cases are neither isolated nor exaggerated.

The pages devoted to illustrations of this very important and much-neglected fact, are many and instructive. The authorities quoted are numerous and trustworthy, and the conclusion is unquestionably sound. Man, by his removal of forest, has done and is doing so much to modify the face of the earth, and what he is doing tends so greatly to alter climate for the worse, that it ought to be a very serious question with governments, whether the removal of forest should not be checked, and the growth encouraged. When forest

lands are cleared, and converted into fields and pastures, the gain to mankind is not so great as it might at first appear.

Among the uses of forests Mr. Marsh includes that of holding up the rocks in mountain districts, and preventing avalanches. That in certain cases they may have done this there is little doubt, although, of course, a forest would not check the descent of an avalanche once in motion.

It is not only for the sake of the timber, or for clearing land for other crops, that forests have been removed. In settled countries they are often cut down for some peculiar or local reason. As retreats of criminals, or as harbouring birds which are believed to steal fruit and grain, trees have been removed in large quantities. In Spain, a country where the effect of wood would be eminently favourable, the superstitions of the people absolutely prevent planting with any chance of success.

As, then, the destruction of forests by man has often had a great and injurious effect on climate—rendering it more extreme, and diminishing the quantity of land covered by vegetation—increasing the torrents in mountain districts, lowering and making irregular the height of water in streams, and reducing the springs over large districts—it behoves men associated under governments to keep apart a certain definite proportion of their lands for forest cultivation, and thus bring back a more favourable condition for the cultivation of the rest of the country.

The effects of human labour in reclaiming from the sea lands already covered with water, and still more in preventing those occasional incursions on border-lands which render them useless and mischievous, are too well known to need remark. Thus, on the east coast of England, half a million of acres of unhealthy marsh, pool, and tide-washed flat, have been converted into healthy arable land and pasture.

Large as this result may seem, it is little more than half that which has been recovered on the opposite shores of Holland. The works by which these great results are obtained, are exceedingly costly, and require incessant and most careful supervision. They are human in their origin, and if left alone for a few years, they would not fail to be destroyed by the constant encroachment of the sea. Whenever, also, the soil is less than four or five feet above low-water level, pumps worked by wind, water, or steam, must be employed to keep the land dry enough for use. There can be no doubt that human influence, by extending the area of low lands near the sea, and at the same time removing a large quantity of surface-water, has affected the climate in the districts where this work has been carried on on a large scale; but a still greater effect has been produced by the lowering of lakes—an operation largely executed not only in Europe but in the East. Such works, by reducing the water-surface of a country, diminish the evaporation, and also the supply to be obtained from springs and rivulets at low levels. Ordinary draining operations carried on largely in cultivated lands, cannot but produce a large result, which is, on the other hand, counterbalanced by the

effects of irrigation—a proceeding far more extensively and successfully adopted in Southern Europe, and generally around the shores of the Mediterranean basin, than persons who have not visited those countries can imagine. In Lombardy alone it is estimated by competent authorities, that every day in summer there is an amount of irrigation "diffusing over 550,000 hectares (1,360,000 acres), forty-five millions of cubic metres (about ten thousand millions of gallons) of water." As near as can be ascertained, the amount of water applied to irrigated lands is scarcely anywhere less than the total precipitation during the season of vegetable growth; and in general it much exceeds that quantity. Spain offers examples on an equally large scale.

The practice of irrigation to this extent very seriously interferes with the quantity of water that would otherwise be conveyed by rivers to the sea. Thus, in the case of the Po, the quantity of water withdrawn is estimated to be equal to the whole water-contents of the Seine, under average conditions. The works now in operation in Egypt are estimated to remove one-fifth of the whole quantity of water carried down by the Nile. The climatic result of this change is often shown in the poisonous and malarious state of the air where irrigation is prevalent. The cultivation of rice, which always requires much water, is uniformly unhealthy. There is reason to believe that the salts (chiefly sulphate of soda and common salt) sometimes now found on sterile tracts, are the results of former irrigation; and that many parts of North Africa, and of Northern and Western India, now barren, were once exceedingly rich. This remark applies especially to the valley of the Nile in Egypt and Nubia, and some parts of the great African Desert.

River dykes confining the course of a stream within definite banks, may be added to the means by which marsh lands are reduced to ordinary soil.

The drainage of the Val di Chiana, and the alterations effected in the *Maremme*, or marsh lands of Tuscany, have produced results on the physical geography of the adjacent country exceedingly remarkable and interesting. The valley of Chiana intervenes between the courses of the Arno and the Tiber; and it has been supposed, that in former times the waters of the Upper Arno may by it have flowed into the Tiber. At present, its waters connect with the Arno. The result of the engineering operations by which this has been effected, is the reclaiming of about 450 square miles of pond, marsh, and sickly swamp, and the improvement of the sanitary condition of the whole district. The natural slope has been reversed, and the water-shed removed thirty-five miles farther south, greatly increasing the Arno, and diminishing or helping to diminish the floodings of that river. On the other hand, the waters of the Tiber have been lowered.

The Tuscan *Maremme* are by no means exclusively marsh lands. The term includes much high land and even mountain peaks, one of which rises to the height of 6,280 feet. The coast, however, is low, flat, and recently formed, and malaria is prevalent to a height of nearly 1,000 feet. By a series of engineering operations, the low wet lands have been gradually filled up; and thus the mud, which would

have formed unhealthy deltas of the river, has been utilized, and now makes the coast more healthy. The quantity of sediment thus made available artificially, is estimated at not less than twelve millions of cubic yards per annum.

Among the larger phenomena of nature capable of being brought under human influence, the checking of the progress of sand-hills must be regarded as one by no means slight or unimportant. To understand the agency of man in fixing or rendering permanent long lines of dunes on an exposed coast, or in a desert subject to winds blowing persistently from some one quarter, the nature and origin of such heaps of loose material must be considered. They are not by any means always of the same nature. The particles of sand, generally siliceous and rounded, are sometimes of other rock and angular. There are sands of garnet, others of black titaniferous iron, some of fine, others of extremely coarse grains. Most of these heaps contain much water, so that by digging into them to a short depth fresh water is reached. Hence, by a systematic planting of certain grasses, their movements onwards may be checked, and in time they become consolidated. Afterwards trees grow upon them, and they undergo little further change. On the other hand, by removing the vegetable covering from some of those formerly existing on the coasts of Flanders, it is not unlikely that the dunes have once more been exposed to the attack of winds. As they often serve as barriers against the sea, it is easy to contemplate the result, should they by any carelessness be allowed to be set in motion. Very serious results of this kind have already taken place, among which may be quoted the irruption of the sea into the fresh-water lagoon of the Lijmfjord, in Jutland, in 1825. This result, which is expressly ascribed to the "mismanagement of the dunes," occasioned changes so remarkable, as to be well worthy of record, and in the highest degree instructive to the geologist. The lagoon was famous for its abundant fisheries. Millions of fresh-water fish were thrown on shore, partly dead and partly dying, and were carted off by the people. A few revived, and still frequent the shores at the mouth of the brooks. The eel has adapted itself to the change, but to the rest the salt has been fatal. It is more than probable that the sand washed in by the irruption covers in many places a layer of dead fish.

At the time of the accident, also, the bottom of the Lijmfjord was covered with a vigorous growth of aquatic plants, belonging both to fresh and salt-water, especially *Zostera marina*. This totally disappeared after the accident, and, in some instances, was buried under sand; but even where there was no sand the *Zostera*, though a marine plant, was destroyed. It is certain, that at some former period there had been a communication between the Lijmfjord and the German Ocean; so that if we could get a clean section through its bottom, we should find beds of *Ostrea edulis* and *Cardium edule*, covered up by a layer of sand, with *Zostera* and fresh-water fish; and this again covered with sand and beds of *Mytilus edulis*. If the new channel should be closed, which it might easily be, the lagoon would be converted first into brackish and then into fresh water, and there would be a further

alternation of marine and fresh-water inhabitants. In all this there are no important changes of the land surface.

The control of dunes by man is effected either by forming them originally by artificial means, by protecting them when natural, or by removing them when that can safely be done. In some places a mere artificial wall will give rise to a broad belt of dune. Thus, in 1610, a wall of three or four miles in length, thrown across a tide-washed flat between the Zuider Sea and the North Sea, occasioned the formation of rows of dunes a mile in breadth, and altogether excluded the sea. Similar results have been obtained by mere plank walls and screens of reeds. Where dunes already exist, they can be prevented from advancing by planting certain grasses, creeping plants, and shrubs, the *Arundo arenaria* being the most valuable. This plant grows to the height of about two feet; but its strong roots and their rootlets extend forty or fifty feet through the sand. The looser the soil the better it thrives, and as soon as the sand ceases to drift it dies, its roots fertilizing the sand and helping to form a vegetable mould for forest planting, pasturage, and ultimately arable land. The leaves of the *Arundo* are nutritious food for cattle and sheep; its seeds feed poultry; cordage and twine are made from its fibres; it thatches well, and its roots are good fuel. So many valuable properties sometimes check its main use as a safeguard against the drifting sands. The beach-grass is an American representative of this plant. On the French coast upwards of 100,000 acres of land have been reclaimed; and in other parts of Europe a very large area.

Of trees to succeed the *Arundo*, none is better than the *Pinus maritima*, where it will grow. Its resins yield, according to the French returns, a clear profit of 20*s.* per acre per annum, exclusively of the value of the timber.

As the plains and dunes of sand on the European coasts are estimated to amount to at least 20,000 square miles, it is evident that much yet remains for human agency in this matter; and as moving sand is invariably mischievous, while fixed sands rapidly become profitable, the subject is one of extreme practical importance.

Great public works—such as the cutting of marine isthmuses, connecting different drainages by canals, and diverting the course of rivers—are occasionally, though very rarely, effected by man; rarely, that is, considering the number of cases in which engineering operations of this nature would alter the mode of communication between distant lands.

There cannot be a doubt that the successful carrying out of the scheme for connecting the Mediterranean with the Red Sea, or that across the Isthmus of Darien, would produce physical changes of the greatest magnitude. Whether these would involve modifications of the surface, is doubtful; but so far as animal and vegetable life is concerned, they could not fail to act. Even the Great Gulf Stream itself might be induced so far to change its course by a wide channel through Central America, as to alter entirely the whole climate of Western Europe. But these are speculative and possible, rather than

known changes, and it is enough to limit ourselves to those that have actually taken place.

There are certain incidental effects produced, not by, but through and on account of, civilization and the passage of man over the earth that are worthy of notice.

A little iron, deposited under peculiar circumstances, will provide material for cementing a large extent of sand. A few street-sweepings have formed the nucleus of a considerable marine deposit. A man in Malta wishing to establish salt works on his land, which was situated over a large cave open to the sea, sunk a well into the cave to draw up the sea-water for evaporation. This opening once made, the sea took advantage of it. During heavy gales, the water was forced up through the well in large quantities, and injured the land around. Once made, the communication could not be stopped. In Italy, Greece, and Egypt, are hills of broken pottery. In Denmark the celebrated kjokken middens are not less remarkable; and there is scarcely an ancient town that does not show an accumulation of material from five to fifteen feet in thickness.

Thus it appears that man not only may influence, but has very seriously and largely influenced, both organic and inorganic nature. So largely is this the case, that even the immediate results are beyond measurement, and what the ultimate and incidental effect may be it is altogether impossible to estimate.

Mr. Marsh's book is a little overlaid with matter already familiar, and diverges occasionally from its professed object—that of recording the influence of man on nature; but it is a valuable contribution to the physical geographer, especially in those departments of his science which bear directly on geological questions. We are bound, therefore, to welcome its author, and thank him for his labours.

THE NEW ZEALAND FLORA.*

At the request of the Colonial Government, Dr. J. D. Hooker has published the first part of a Handbook of the New Zealand Flora. It contains the flowering plants and ferns with their allies. The second part, which will be shortly published, will contain the remaining orders of Cryptogamic plants, with index, catalogue of native names and of naturalized plants. Dr. Hooker published in 1854–5, the second part of the 'Botany of the Antarctic Expedition of Sir J. Ross,' containing the Flora of New Zealand, in two volumes, quarto, with 130 coloured plates of New Zealand plants, including 1,060 species. No one was better fitted to draw up a compendious Hand-

* 'Handbook of the New Zealand Flora: a Systematic Description of the Native Plants of New Zealand, and the Chatham, Kermadec's, Lord Auckland's, Campbell's, and Macquarrie's Islands.' By J. D. Hooker, M.D., F.R.S., L.S., and G.S. 8vo. London: Reeve & Co. 1864.

book; and although the present work is confessedly and necessarily incomplete from the want of materials, still it gives a good view of the orders, genera, and species of the islands. "Much remains to be done towards the botany of the Northern Island especially; of the whole province Taranaki, nothing is known; and except the Ruahine range by Colenso, no mountain region has been approximately well explored. Then, too, of the outlying islands, as the Kermadec and Chatham Islands, very little is known, and of Bounty or Antipodes Island, nothing; whilst much remains to be collected on Lord Auckland's group, Campbell's Island, and Macquarrie Islands. The materials are still wanting for a comparison of the volcanic mountains of the Northern Island with the primitive or other mountains of the Middle Island, a comparison essential to make, before the geological or climatic relations of the Flora of either island can be ascertained."

Dr. Hooker gives the following interesting details relative to the labours of those who, as collectors or authors, have contributed to our knowledge of the New Zealand Flora.

In August, 1769, Sir Joseph Banks and his companion, Dr. Solander, visited the islands in Captain Cook's first voyage, and collected in Poverty Bay, Tegadoo, Tolaga, Opuragi, the Thames River, Bay of Islands, Queen Charlotte's Sound, and Admiralty Bay. They obtained about 360 flowering plants and ferns, had folio drawings made of most of them, and excellent manuscript descriptions.

In 1772, Captain Cook again visited New Zealand, accompanied by the two Forsters, Reinwold and George (father and son), and by Dr. Sparrman; they collected at Dusky Bay and Queen Charlotte's Sound. Their herbarium amounted to only about 160 species of flowering plants and ferns.

In 1777, Captain Cook, during his third voyage, visited New Zealand. On this occasion, Mr. Anderson, his surgeon, was the botanical collector, who obtained very little indeed, and nothing of any importance.

In 1791, Captain Vancouver arrived in Dusky Bay, on his way to survey the coasts of North-west America, having with him as surgeon Mr. Archibald Menzies, a very assiduous collector of flowerless plants, who procured many species of *Filices*, *Musci*, and *Hepaticæ*.

In 1822, Captain Duperry visited the islands in the French discovery corvette 'Coquille,' when one of his officers, the late Admiral D'Urville, made excellent collections.

In 1827, Captain (afterwards Admiral) Dumont D'Urville again visited New Zealand in the same ship, renamed the 'Astrolobe,' accompanied by an able naturalist, M. Lesson, when additional botanical collections were made in Cook's Straits, the Thames River, and the Bay of Islands. The materials of this voyage (containing upwards of 200 flowering plants and ferns) were published by M. A. Richard, in his 'Essai d'une Flore de la Nouvelle-Zélande,' with folio plates. (Paris, 1832.)

In 1825, Mr. Charles Fraser, then superintendent of the Sydney Botanic Gardens, landed for one day in the Bay of Islands, and made a small collection of dried plants. He, however, procured more living

ones, some of which were amongst the first plants of the islands which were introduced into European gardens.

In 1826, and again in 1838, Allan Cunningham, the eminent Australian botanist and explorer, made extensive botanical explorations in the northern parts of the Northern Island, chiefly at the Bay of Islands; and in 1833 his brother, Richard Cunningham, (Fraser's immediate successor in the Sydney Gardens), was sent in Her Majesty's ship 'Buffalo' to procure timber for the Australian government. The results of the labours of the brothers, and especially of Allan, whose arduous exertions in the islands led to his untimely death at Sydney in 1839, added considerably to the known Flora, and were collected by Allan into his 'Floræ Novæ-Zelandiæ Præcursor,' which was published by Sir W. J. Hooker, partly in his 'Companion to the Botanical Magazine' (vol. ii.), and partly in the 'Annals and Magazine of Natural History' (vols i., ii., iii.).

In 1840 and 1841, the French frigate 'L'Aube,' and in 1842–3, another, the 'Allier,' made a lengthened sojourn at the islands. During those occasions, M. Raoul, a very intelligent medical officer, diligently explored Banks's Peninsula and the Bay of Islands, making excellent collections at the former locality especially; most of the new species discovered were published first in the 'Annales des Sciences Naturelles' (series iii., vol. ii., p. 113), by MM. Raoul and Decaisne; and more recently were described and figured in a beautiful work, entitled 'Choix des Plantes de la Nouvelle-Zélande,' which further contains thirty plates, and an enumeration of all their known New Zealand plants.

In 1841, the Antarctic expedition visited the Bay of Islands, when accompanied by his friend the Reverend W. Colenso and by Dr. A. Sinclair, during a part of the time Dr. Hooker was enabled to explore the neighbourhood very fully, and to add largely to the Cryptogamic Flora.

In 1847–9, Capt. Stokes, R.N., in Her Majesty's ship 'Acheron,' surveyed the coast of New Zealand; he was accompanied by Dr. Lyall, who made very large and excellent collections, especially of flowerless plants, on various parts of the coast, but chiefly of the Middle Island.

The other collectors to whom Dr. Hooker is principally indebted for the materials published in the 'Flora Novæ-Zelandiæ,' are, firstly, the Reverend W. Colenso, who, during many successive years, has collected throughout the whole length of the Northern Island, with great care and skill, discovering more new and interesting plants (especially on the Ruahine Range, Tongariro, Hikurangi, &c.) than any botanist since Banks and Solander. The late Dr. Andrew Sinclair, R.N., F.L.S., formerly Colonial Secretary, a man of great attainments in many ways, certainly ranks second to Mr. Colenso. He collected very copiously in the Bay of Islands, the Auckland districts, and in the Nelson mountains, and was engaged in a botanical exploration of the Southern Alps in company with Mr. Haast, when he was drowned in the Rangitata river.

The first Alpine collections were made by J. T. Bidwill, Esq., of Sydney, who was the earliest explorer of the interior of the Northern

Island; and in 1839, ascended the lofty, active volcano Tongariro, incurring considerable danger.

The same mountains have been still better explored by Dr. Munro, who has added many beautiful Alpine species to the 'New Zealand Flora.'

In 1840, Dr. Dieffenbach visited many parts of the Northern Island and northern part of the Middle Island, and is the first person who ascended Mount Egmont.

The great opportunities enjoyed by the distinguished geologist and explorer, Julius Haast, Esq., F.L.S., F.G.S., Government Geologist of Canterbury, have been used to the best advantage in the furtherance of botanical science, he having contributed more new species to the Flora of the islands than any collector since Mr. Colenso.

From the Otago province, Dr. Hooker had an excellent herbarium of Dunedin plants, made by Dr. Lander Lindsey, F.L.S.; and more recently, very extensive and valuable collections, containing much novelty, from the Alps of the interior and west coasts, by another eminent geologist, Dr. Hector, F.G.S., Government Geologist, and Mr. Buchanan, his assistant.

To render the Handbook more complete, Dr. Hooker has included Chatham and Kermadec Islands, Lord Auckland's group, and Campbell's Island. Of about 100 flowering plants, natives of these small groups, no less than 27 are hitherto unknown in New Zealand proper, including three genera and twelve most conspicuous and singular species—*viz. Ligusticum latifolium* and *antipodum*, *Pleurophyllum* (two species), *Celmisia vernicosa*, *Gentiana* (two species), *Plantago antarctica*, *Chiloglottis cornuta*, *Antherieum Rossii*, *Rostkovia* (two species).

Of the 303 New Zealand genera of flowering plants described in this part, about 252 (containing 222 species and 51 representatives) are common to Australia; 174 (containing 11 species and 32 representatives) to South America; 31 are peculiar to the group (comprising 59 species); and 6 (with 20 species) are found in the Pacific Islands and elsewhere, but not in Australia or South America.

Again, of the 935 species of flowering plants, 677 are peculiar to the Islands, 222 are Australian, and 111 American. There are, further, 51 Australian representative, and 32 American representative species.

Comparing New Zealand with Europe, these countries have 115 genera and 58 species in common, the latter including many water-plants and several land-plants, which are doubtful natives. Of these European genera, the shrubby *Veronicas* and *Ligusticum* are the only ones that appear to be vastly more numerous in New Zealand than in Europe.

The work is a most able and valuable one, and cannot fail to promote the study of botany in New Zealand, and thus to add to our knowledge of the distribution of plants. It is prefaced by brief outlines of botany from Bentham's 'Flora Australiensis,' with a glossary, and a classification of the orders, and genera.

FLORA OF THE BRITISH WEST INDIAN ISLANDS.*

By the exertions of Sir William Hooker we are now in the fair way of having a complete series of Colonial Floras, under the patronage of Government. Dr. Grisebach's work on the Flora of the West Indies is one of them. The concluding part has just been published. The British Government granted 300*l.* to meet the necessary expenses. Dr. Grisebach has had free access to the Hookerian Herbarium and to that of the British Museum. He has, moreover, received collections from various botanists who have visited different Islands in the West Indies. This Flora is intended to be a synopsis of all flowering plants and ferns as yet known to inhabit the British West Indian possessions. Some cultivated plants are noticed which are said to be naturalized in the country.

"Though reaching beyond the tropics (N. L. 10°—27°), the West Indian Islands present an entirely tropical character in their vegetable productions, and the Northern Bahamas in this respect are quite distinct from the opposite continental shore of Florida, from which it is separated by the Gulf-stream; while Trinidad, lying almost contiguous to the Delta of the Orinoco, partakes of the Flora of Venezuela and Guiana. Jamaica, again, from its mountainous character and more distant position—most of the Leeward Islands, from being wooded volcanoes—and the majority of the Windward ones, with a dry climate and a low calcareous soil—form three divisions of this tropical archipelago, which show as many peculiarities. Thus the whole of the British West Indies, as comprised in this 'Flora,' may be divided into five natural sections, each with a distinct botanical character, and including the following islands, the geographical area of which is added according to the 'American Almanac for 1858,' and other sources:—

			English square miles.
I.	27°—21° N. L.	Bahamas	5,420
	21°	Turk Islands	400
II.	19°—18°	Jamaica	5,470
III.	Western Caribbean Islands (most Leeward, and including some of the Windward Islands).		
	18°	Virgin Islands	140
	17°	S. Kitts	70
	„	Nevis	30
	16°	Montserrat	50
	15°	Dominica	290
	14°—13°	S. Lucia	225
	13°	S. Vincent	130
	12°	Grenada and Grenadillos	155
IV.	Eastern Caribbean Islands (most Windward, and some Leeward Islands).		
	18°	Anguilla	30
	17°	Barbuda	90
	„	Antigua	100
	13°	Barbadoes	170
	11°	Tobago	190
V.	10°	Trinidad	2,000

Thus the territory comprised may be estimated as amounting to about

* 'Flora of the British West Indian Islands.' By A. H. R. Grisebach, M.D., F.L.S., Professor of Botany in the University of Göttingen. London: Lovell Reeve & Co. 1864.

15,000 English square miles, or nearly twice as much as the area of Wales. Haiti alone is nearly twice as large as the whole of the British West Indies; Cuba surpasses them almost three times, and this will account for the fact that, considerable as were the materials at command, and great the exertions of so many excellent collectors, the number of novelties in the 'Flora' is, comparatively speaking, small, while Cuba affords a daily increasing number of unpublished species. Considering, at the same time, how neglected by botanists Cuba has been, if we compare it with the standard works of men like Jacquin and Swartz, whose publications with regard to the West Indies were almost confined to the British possessions, it will appear probable that by far the greatest part of the plants of our territory consists of old species, these indeed being the foundation of our scientific knowledge of the Flora of tropical America."

Almost all the principal authors who have written on West Indian plants belong to the last century, when nothing was known of a natural arrangement, and no synopsis has been previously given of the Flora, and of no part of the British West Indian Islands has a tolerably complete 'Flora' ever been published since the time of Patrick Browne, whose 'Flora of Jamaica' appeared in 1756. Among the writers on the West Indian Flora may be mentioned Sir Hans Sloane, Linnæus, Plumier, Jacquin, Olaus, Swartz, Vahl, Tussac, Lunan, Descourtilz, Hamilton, Maycock, Macfadyen.

The author has followed pretty nearly the Candollean system, except that he has given up the Monochlamydeous division, and incorporated the Apetalous plants with the other sub-classes of Dicotyledons. The work has been executed with great care, and the author has been aided in his labour by Dr. Hooker. This publication supplies a desideratum which has been long felt, and its execution reflects the highest credit on Dr. Grisebach. A tabular arrangement is given of the natural orders according to the typical characters and a copious Index is added.

AUSTRALIAN FLORA.*

Mr. Bentham and Dr. Muller have published the second volume of their 'Australian Flora,' containing the species included in the Orders Leguminosæ, Rosaceæ, Saxifrageæ, Crassulaceæ, Droseraceæ, Halorageæ, Rhizophoreæ, and Combretaceæ. The first of these Orders, the Leguminoseæ, occupies 424 pages. Excellent analyses are given of the genera and of the species, and the publication is in every respect worthy of the botanical reputation of its authors. The services of Dr. F. Muller, the superintendent of the Melbourne Botanic Garden, have been of great value. He has already published works on the Australian Flora, and is placed in circumstances which have enabled him to clear up many doubts and difficulties which a botanist resident in Britain could not have accomplished. The work is a fit companion to the 'New Zealand Handbook.'

* 'Flora Australiensis: a Description of the Plants of the Australian Territory.' By George Bentham, F.R.S., F.L.S.; assisted by Ferdinand Müller, M.D., F.R.S. and L.S., Government Botanist, Melbourne, Victoria. 8vo. London: Lovell Reeve & Co. Vol. II. Pp. 521.

BRITISH AND GARDEN BOTANY.*

Mr. Leo H. Grindon, Lecturer on Botany in Manchester, has published a work on this subject, containing descriptions of the flowering plants, ferns, and trees indigenous in Great Britain, with notices of all plants commonly cultivated in this country for use and ornament. The work is intended to be popular, and it is prefaced by a brief introduction to the study of Botany. The author takes credit to himself for having published a work superior to all others as regards the intelligible way in which the natural orders are described. and as regards the excellence of the Key for finding out the particular families, genera, and species of plants. In place of sounding forth his own praise, and contrasting his own work with others, we think that the author would have acted more judiciously if he had followed Solomon's rule—"Let another man praise them, and not their own mouth; a stranger, and not their own lips." He thinks the Key in his own work superior to those given by Babington and Bentham, because among other things it does not require the ripe fruit to determine the plant; the learner he says can find out the name of the plant while it is in flower. We do not know that he has completely succeeded in this, and in some cases he has actually had recourse to the ripe fruit as part of the characters in the Key. Moreover we are doubtful whether the fruit is not in many cases absolutely essential to determine the plant with accuracy, or at all events with scientific precision. Mr. Grindon probably thinks that for popular works such minute accuracy is not required. The author states that his desire is "to introduce the lover of plants by the easiest and pleasantest path, to an intimate knowledge of everything growing wild in the field and woods, upon the shores, in the streams and on the mountains of our native islands, and to give along with this some few particulars respecting such flowers and trees cultivated in gardens, shrubberies, and greenhouses, as are frequent and likely to attract attention." No generic characters are given, because the author says, "Genera can only be learned from the contemplation of many species of a genus, and as a very large number of British genera contain only one native species each, there is nothing for the student to compare and collate." We are disposed to think that the study of genera is far more important than that of species, and we would rather see our young students attending primarily to orders and genera than entering into the minutiæ of specific distinctions, more especially as given in some works of the present day. There can be no doubt that some have expressed a desire for a book which would treat of the common garden plants as well as of the native ones, and to a certain extent this work is meant to supply the desideratum. It is a combination of what is found in other introductions to Botany with a British flora. We are disposed to think that the two are best separate, and that the bulk of the present work will prevent it from being used as a field-book. The great use of

* 'British and Garden Botany.' By Leo H. Grindon, Lecturer on Botany in the Royal School of Medicine, Manchester. London: Routledge.

a British flora is in the field, and a botanist would find it no easy matter to climb the hills with such a heavy tome in his pocket. Still the book may be useful to home botanists who are content with easy walks in the garden.

On a cursory glance we have noted some inaccuracies. *Ranunculus sceleratus* is said not to be found in Scotland, which is a decided mistake; the plant is tolerably common. *Trollius europæus* is noted as being found in the lowlands of Scotland, whereas it extends high up on the mountains. Also *Geranium pyrenaicum* is spoken of as being naturalized in Britain and Ireland. The plant is undoubtedly wild in many parts of Scotland. *Erica ciliaris* should have been mentioned as being found in Ireland as well as England. *Sagina nivalis* is not recorded as a British plant. It is found abundantly on Ben Lawers, and other Scotch mountains. We cannot agree with the author in thinking *Alsine rubella* as not distinct from *A. verna*. Little Craigindal is said to be the only locality for *Astragalus alpinus* in Britain, whereas the plant occurs also in Clova, where it was first discovered. *Saxifraga Hirculus* is put doubtfully native of Scotland. The plant has been found in several localities in Scotland truly wild. *Orobanche rubra* is not confined to the Western shores of Scotland; it is also found on the Eastern shores. *Œnanthe crocata* cannot be called uncommon in Scotland. *Crithmum maritimum* is not noticed as occurring plentifully at the Mull of Galloway and other parts of the South-west of Scotland. *Scirpus Savii* also is not mentioned as being a Scotch plant found also in Galloway. There are many other mistakes and omissions of a similar character which call for careful revision. There is a deficiency of woodcuts, and those which are given are not well printed. Indeed the general typography of the book is not first-rate.

SOUTH AFRICAN BUTTERFLIES.*

One of the chief discouragements attending the pursuit of natural history in many parts of the world is the great difficulty which collectors find in identifying their specimens, or in obtaining any reliable information respecting them. Many a settler in a remote colony with a sufficiency of leisure, and not without inclination for the study of natural objects, has been deterred by the want of books of reference, such as those which assist the zoologist or the botanist in our own country. This deficiency, so far as it affected the butterflies of South Africa, has been very admirably supplied by Mr. Roland Trimen, the first part of whose work, containing five of the ten families of Rhopalocera found in South Africa, is now before us.

* 'Rhopalocera Africæ Australis: a Catalogue of South African Butterflies, comprising Descriptions of all the known Species, with Notices of their Larvæ, Pupæ, Localities, Habits, Seasons of Appearance, and Geographical Distribution.' By Roland Trimen, Member of the Entomological Society of London. Part I.—'Papilionidæ, Pieridæ, Danaidæ, Acræidæ, and Nymphalidæ." Cape Town: W. F. Mathew, Steam Printing Office, St. George Street. 1862.

A short introduction contains a summary description of the habits and transformations of butterflies in general, with so much of their structure and anatomy as, taken in connection with the single plate at the end of the part, may serve to render intelligible the characteristic distinctions of the genera and species given in the body of the work. The description of each species includes the name with a list of synonyms; a detailed account of the characters of the male and female, larva, pupa, and varieties; followed in many instances by a very readable and pleasant notice of the peculiar habits of the insect, its mode of life and geographical distribution; concluding with a reference to the various localities in South Africa where it has been taken.

Of the fifteen families of butterflies, ten only are represented in South Africa. The first family, Papilionidæ, of which about four hundred species have been described, "is very widely distributed throughout the greater part of the world, and contains some of the largest and most splendid butterflies known." "Only eleven species have hitherto been captured in South Africa." In Britain we have a single species, the well-known swallow-tail butterfly, P. Machaon. The beauty of the Papilionidæ attracts the notice even of the uncultivated savage. "The natives of Darnley Island are accustomed to capture O. Poseidon, and securing it by one end of a long thread, they fasten the other end of the thread to their hair, allowing the insect to flutter round their heads."

The species of the second family, Pieridæ, familiarly known as the "Whites," are numerous in South Africa. Mr. Trimen's remarks on this group remind the British collector of the habits of our native "Whites." The Pieridæ are perhaps of all butterflies most inclined to be gregarious, and sometimes appear in almost incredible numbers. The writer once encountered in a valley in the South of Palestine a flight of butterflies, apparently P. Cratægi, which for a quarter of a mile resembled flakes of falling snow, the air above and on all sides being literally filled with them.

The South African Danaidæ comprise four species only, characterized by ochreous and white markings on a ground of velvety brown or black. Of D. Echeria, the author says:—"The flight of this handsome insect is more graceful and floating than that of any other South African butterfly I have seen on the wing. At the Knysna, where it was common in the woods, it was one of the earliest on the wing of the forest butterflies, and very pleasant it was to stand quietly in some dewy open, and watch Echeria take her gentle flight through the cool air. On a warm still day this species will keep at a considerable elevation, floating across an open spot, flapping its wings twice or thrice, and then quietly pitching on some projecting twig, remain motionless, generally with the wings closed, and hanging downwards. On a windy day they fly lower and settle more frequently, when they are usually not difficult to capture."

The family Acræidæ is essentially an African one. Thirty-five of the forty-six species enumerated by Mr. Doubleday, in the 'Genera of Diurnal Lepidoptera,' being found in Africa and its islands. Of the remaining eleven, two are Asiatic, eight American, and one

species from Australia. "The Acræidæ frequent the open parts of woods, and even the more shaded parts, where only here and there a ray of sunshine that has stolen through the dense foliage of the trees plays on the scanty undergrowth of low shrubs or herbage. Their flight is rather slow and feeble."

The fifth family, Nymphalidæ, contains a large proportion of the butterflies with which we are most familiar. Mr. Trimen describes thirty-four species as natives of South Africa. This number exceeds by four that of the representatives of the same family in Britain; one species, P. Cardui, being common to both countries, and, in fact, to almost every temperate or tropical part of the world. The writer recollects having had an eager but somewhat circumscribed chase after this insect on the apex of the Great Pyramid.

It is not too much to say, that the scientific entomologist will find the present volume, in its typography and general arrangement, executed on the most approved model for works of this kind; and that the amateur who collects the splendid butterflies of South Africa will admit that a new zest has been imparted to his work, by a ready access to rich and varied stores of information.

CHEMICAL ANALYSIS.*

In noticing a work on Chemical Analysis, it might not be without interest to the general reader if we could give, in untechnical language, a general outline of the method pursued in this most interesting branch of study. But the difficulties in the way of this appear to us insuperable.

Chemistry has been defined as the science which teaches us the properties of elementary substances, and of their mutual combinations. Chemical Analysis is the art—founded upon a knowledge of these properties—of separating these substances one from another in mixtures and combinations, and determining the exact amount of each present.

We are to-day acquainted with sixty-four elementary forms of matter, or, at all events, substances which no means now at our disposal will enable us to resolve into simpler forms. The mutual combinations of these elements are infinite in number.

Of the elements a few are gaseous, two are liquid, and the rest are solids, mostly belonging to that class of bodies which are termed metals. Presenting many resemblances which allow us to class together several substances in various groups, according to many relations; each one, nevertheless, has a distinct individuality, and possesses characteristics which permit us either to fix it in some definite compound, or to isolate it altogether, and thus determine the exact proportion present in whatever combination it may exist.

* 'A Manual of Chemical Analysis, Qualitative and Quantitative. For the use of Students. Part I. Qualitative. Part II. Quantitative.' By Henry M. Noad, Ph.D., F.R.S., &c. London: Lovell Reeve & Co., 1864.

With the more common constituents of our earth, the means of identification are comparatively simple. Supposing a mixture containing all these, six general tests divide them at once into six groups, and thus one great step is taken towards their individual recognition. The further steps are indeed not so simple, but slowly and surely the student proceeds until he has recognized every one of these bodies by some decisive reaction.

But the detection of a body which is made in a qualitative analysis, and its complete separation and determination by weight in what is called a quantitative analysis are two very different matters. The first is a comparatively simple proceeding; to the latter there is sometimes an insuperable obstacle, and it becomes necessary to infer the amount of a substance by the difference remaining when everything else in a given weight of a mixture has been determined.

The reader thus sees that analytical chemistry is no child's play. To pursue it successfully requires no little skill in manipulation, no little perseverance, and above all things, no little patience. To students gifted with these, few pursuits are more fascinating; but without them, few pursuits probably are more disappointing.

With regard to Dr. Noad's book we have but little to say, and that little must be in commendation. To those who commenced the study of chemistry fifteen or twenty years ago, few books are better known than the excellent manual which Dr. Noad wrote, we believe, for the Society for the Diffusion of Useful Knowlege. The present work is the analytical part of the former book brought up to our present knowledge of the subject. The quantitative part is a compilation of all the best processes which have been devised, made by one thoroughly acquainted with analysis; and although the book is stated to be "for the use of students," this part will serve as a work of reference to those whose students' days may be said to have passed.

THE ASTRONOMICAL OBSERVER.*

It is not the good fortune of many who take a great interest in Astronomy to possess an equatorially-mounted telescope; and to such as have only the use of an instrument mounted on a plain stand, the observation of objects invisible to the naked eye presents some difficulties. By the compilation of this Hand-book, Mr. Darby has rendered an essential service to amateur astronomers, and more especially to those who cannot afford an equatorial; for the most useful feature of the work, and an original one, is that directions are given for finding objects with a plain telescope, the stars visible to the naked eye serving as pointers to the invisible objects.

The work consists of a catalogue of the constellations with the most interesting telescopic objects,—nebulæ, clusters, and double stars,

* 'The Astronomical Observer. A Hand-book to the Observatory and the Common Telescope.' By W. A. Darby, F.R.A.S. London: Hardwicke. 1864.

in each. For every one of these, the Right Ascensions and Declinations brought up to 1865 are given; and besides these there are, as often as possible, directions similar to the following for finding the great nebula in the constellation Andromedæ: "An imaginary line drawn in the heavens from the star β Andromedæ, over the star μ Andromedæ, and produced as far again beyond, will place the nebula in the field of the telescope, with a low power eye-piece."

We should have said that the catalogue has been specially prepared with reference to the large maps of the Society for the Diffusion of Useful Knowledge; and that the possession of those maps is essentially necessary to its use by the observer with a non-equatorial telescope.

The introduction contains valuable instruction in the use of instruments, catalogues of test objects, and a table of Refractions which will be found very useful.

PAMPHLET.

Sericulture in Oudh.*

Dr. Bonavia has published, in the form of a pamphlet, printed at Lucknow, during the year just closed, an account of the advance and prospects of the acclimatization of the silkworm, and of the production of silk in the province of Oudh, which, considering the short time that the experiments have had to bear fruit, may be considered as encouraging. Silkworm experiments with China and Cashmere worms have been conducted at Fyzabad, Seetapore, Baraitch, as well as at Lucknow; the latter under the superintendence of Dr. Bonavia. The China worms, however, became very sickly in the month of October, which he attributes to the alternations of temperature—the hot days and cold nights of that month. Nor could they be reared during the cold months of November, December, and January. The Cashmere worms did not yield very favourable results at first, the cocoons being difficult of reeling, and the thread often becoming entangled and continually breaking. Nevertheless, a report of the Agri-horticultural Society of India states that the native reelers, after a week's training, improved greatly, and the quality of the silk is described as excellent, though rather uneven. Two other kinds of worm have been experimented on, namely, first the Boro-Pooloo silkworm of Bengal, which produced good cocoons, which reeled very well. This, which is described as a very good sort of worm, produces cocoons for the most part perfectly white, but many are yellow, and some white with a greenish yellow tinge, and of it Dr. Bonavia remarks, that if he were rearing silkworms for commercial purposes in Oudh, he should certainly prefer, for the winter crop, the

* 'Sericulture in Oudh.' By Dr. E. Bonavia, Hon. Sec. Agri-horticultural Society of Oudh. Lucknow: R. Craven. 1864.

Boro-Pooloo, either to the Cashmere or the other species. This other species is the Bokhara worm, which yielded cocoons, firm, large, and full of silk. The sudden heat, however, of the middle of April caused them all to turn yellow and die. The thread, too, turned out to be weak, and did not reel easily. But it is the China and the Boro-Poolo which appear to offer the best prospects of success, the former a monthly worm, that is, taking about thirty-three days from the time of hatching to the birth of the next generation, which, however, can only be reared in Oudh in June, July, August, and September; while the latter is an annual, and can easily be reared in February and March. In November, December, and January, on account of the cold and the absence of leaves,—and in April and May, on account of the dry heat, no silkworms can be reared with advantage on a large scale in Oudh, but if the proper temperature can be maintained, small quantities may be reared for the purpose of keeping up the stock.

Large and lofty mulberry trees, though apparently they contain plenty of food, are not of the most useful kind; low and wide-spreading trees are the best, because the leaf-gatherers are able to walk round the trees, using both hands to pluck leaves, and every arrangement that saves time and labour is gain. In small experiments the worms were kept in trays made of strips of bamboo, woven into mats, and the dry leaves were constantly removed, and fresh supplied in their place. Great pains, too, were necessarily taken to preserve the worms from the attacks of ants, for a few ants on a tray will kill thousands of worms in a very short space of time, going about and biting one after another, and in this way narcotizing them, possibly with a view of carrying them away at their leisure, and producing effects very similar to those of a snake-bite upon larger animals.

The conclusions which Dr. Bonavia has come to with regard to whether silkworm-rearing in Oudh can be made a paying concern, are—that the China and Boro Pooloo worms can be easily reared in the months above indicated, and that besides the annual crop of the Boro-Pooloo, *three or four crops* can be had between June and September, from the China worms. A proper rearing house, furnished with everything that is necessary to regulate the temperature, is indispensable. It should be situated *in the midst* of a mulberry plantation, proportionate in size to the number of the worms. The *kind of mulberry* to be preferred, is that called by natives the "Dasee Shahtoot," which naturally grows tall, but must be kept down. *Morus cucullata* is only of use when the worms are in their first stages; but whatever kind of tree be used it will require abundant watering during the hot winds. The dry leaves of the trees, and the dung of the worms, will be profitably used as manure. Lastly, the reelers should be good ones, and the silk reeled for the home market. Silkworm operations are most likely to pay, not on land situated in the vicinity of cities, but on land which is now being cleared; since in the vicinity of cities necessaries, rather than luxuries, are most in demand, and such districts will always be found more profitably employed in producing food for man.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

MEETING AT BATH, September, 1864.*

It was necessary for us to omit some of the later proceedings of the British Association in our notice of the meeting last quarter, owing to the too near proximity of our day of publication with the meeting of these sections. We now proceed to supply the deficiency by recording abstracts of the most important papers, hitherto unrecorded, which were read before the Physical, Chemical, and Natural History sections; and we may add, that a Geological paper of importance will be found in our chronicles of that branch of science.

Physical Science. (Section A.)

On Tuesday, the first paper in this section was by Mr. F. Jenkin, who read the Report of the Committee on Electrical Standards. The object of the committee was, first, to select two suitable standards for electrical measurements, and next to decide upon their construction, so as to ensure agreement in measurement. Last year it was determined to measure by units, the fundamental standards being of time, force, and length. The committee now proposed to construct standards and issue them from Kew. Dr. Matthiessen found that lead was the best metal for their reproduction, or, at all events, the choice lay between lead and mercury.

A discussion then took place on spectroscopes, Mr. Gassiot reading a short paper on the "Adaptation of Bisulphide of Carbon Prisms," and the use of telescopes of a long focal length in the examination of the solar spectrum, with a view of counteracting the difficulties arising from change of temperature. Mr. Browning exhibited a new form of spectroscope, in which direct vision was obtained with a single prism. Professor W. B. Rogers stated that he had heard from Professor Cooke, of America, who was preparing to replace his bisulphide prisms by glass ones.

Professor Rogers then described Ritchie's improvements in the liquid compass, as used in the American Monitors. The liquid is a mixture of water and alcohol, and the band of needles is so placed that the disturbances arising from the oscillating motion of the ship is reduced almost to zero. The professor stated that he had seen one of these compasses taken by a porter, who ran with it backwards and forwards, up and down, from side to side of a rough floor, without any perceptible variation in the accurate pointing of the needle; and it

* Concluded from vol. i. p. 746.

might be swung round and round without causing more deviation than half a point.

Two interesting astronomical subjects were brought forward. One afforded a fine material for discussion, and has this advantage over most similar subjects, that it will be absolutely impossible for it ever to be decided. The Rev. T. Webb brought forward Hansen's hypothesis, that the centre of gravity of the moon did not coincide with the centre of the figure of the lunar globe; and hence there was a possibility that the visible hemisphere of the moon, in reference to its whole volume, was one gigantic mountain, in relation to which the other side would present a region of comparative depression, consisting of air, earth, and water, and peopled with a race of beings something like ourselves. The speaker said there was considerable interest in the various arguments which might be advanced on either side of this hypothesis; and the members of the section therefore entered into the discussion with spirit, without however, settling the question one way or another. The reverend gentleman subsequently exhibited a silvered glass speculum—a material which is now being applied to the manufacture of telescopes with great success; and Mr. Brothers exhibited some photographs of the moon, nearly a yard in diameter.

The second astronomical paper was by Mr. Birt. It entered into the subject of the telescopic appearance of the sun, and discussed the various sides of the "willow-leaf' controversy.

Professor Fuller then read a short paper, by Mr. Waugh, on the "Spectrum of Polarized Light," and another, by Mr. S. Highley, describing a cheap form of electric lamp.

The proceedings finally closed with a paper, by Mr. Birt, explanatory of a series of diagrams exhibiting the excessive variations of the wind and atmosphere, as recorded by Mr. Hartnup, the Liverpool astronomer, during three days before, and two days after, the great storm of December, 1863.

Chemistry. (Section B.)

On Tuesday, September 20, the first paper brought forward was by Professor Wanklyn, on a curious example of Etherification. Mr. Vernon Harcourt next read an interesting paper on the rate of Chemical Change. It would be out of our power to give anything like an intelligible abstract of this important paper in the space at our disposal.

Professor Roscoe then explained his Chemical Photometer for Meteorological purposes, and described the results which he had already obtained with it at Manchester. By means of this instrument it would be easy to obtain the daily curve of the chemical intensity of sunlight at any given spot. He employed for this purpose photographic paper prepared in such a way that the same tint on the paper always corresponded with a definite amount of light. Hence, if several prepared papers were exposed to a constant light for varying

periods of time, or for the same time, to light of different degrees of intensity, their tints would be found to vary in the same ratio as the light or the time. The time during which the papers were exposed was read off by the pendulum photometer, and the degree of tint attained was examined by the light of a soda flame.

Professor Rogers then described various pieces of apparatus which he had devised for testing illuminating gas chemically and photometrically. In the photometric testing he had discarded the candle, which was very inaccurate, and used a lamp in which was burnt oil of a certain specific gravity. The description of the various pieces of apparatus could not be rendered intelligible without diagrams.

Dr. Paul, in a paper "On Useful Applications of Slag from Iron Smelting," suggested the grinding it to dust, and mixing it with lime, when it could be moulded into bricks by powerful pressure. These bricks required no fire, but could be used at once, the influence of the atmosphere producing a slow kind of hardening.

Zoology and Botany. (Section D.)

An interesting account of the recent successful attempt to introduce the ova of the salmon into Australia, was read by Mr. T. Johnson.—

In January, 1864, 181 boxes of common deal, measuring 12 inches by 9 inches, by 5 inches deep, containing upwards of 100,000 salmon ova and 3,000 trout ova, were arranged in an ice-house, holding over 30 tons of Wenham Lake ice, on board the ship 'Norfolk.' On arriving at Melbourne, 11 boxes were retained, and the remainder forwarded to Tasmania. The ova were deposited in properly prepared gravel beds; and of the 103,000 sent out, upwards of 31,000 were alive. The death of so many on the voyage was ascribed partly to some of the ova not being in the best condition at starting, partly to the moss on which they were laid being in bad order, partly to some of the ova being frozen before starting, and lastly, to the bilge-water of the ship entering the ice-house. Considerable mortality also took place amongst the ova after being deposited on the gravel beds, but diminished as the season grew colder. The first fish was hatched in Tasmania on the 4th, in Melbourne on the 7th of May; the last on the 8th of June, 54 days after arrival at Tasmania, and 147 days after impregnation. On the 20th of June only 3,300 of the young fish were alive and healthy, so great has been the mortality amongst them. The author invited the co-operation of salmon-breeders, in order to determine the cause of this mortality and devise means to check it.

Dr. Daubeny read a paper, in which he assumed as an acknowledged fact, that species, as well as individuals, have a limited period of existence, but that certain natural contrivances are provided for postponing this inevitable termination to a later period than would otherwise happen were not such a provision made. It was suggested, that in the vegetable kingdom, the introduction of new varieties was an important means of prolonging the life of a species.

In a paper "On the Food of Birds," Mr. C. O. Groom pointed out that the food varied according to the season of the year; that it was wise to protect insectivorous birds; and that the house sparrow only lived upon grain during the winter months, and at other times of the year on insects and vegetables.

An elaborate paper "On the Pedicellaria of the Echinodermata," was read by Dr. Herapath. He regarded these structures as proper to the animals on which they occur, and not as parasites. Their forms are characteristic of the species on which they are found, so that various of the Echinodermata may be recognized by their Pedicellaria.

Mr. C. Spence Bate described the contents of an ancient Kitchen-midden, which he had examined, near the church of Constantine, on the north coast of Cornwall. A shell bed containing the limpet, smaller whelk, and mussel shells, was met with, together with bones of the sheep, lamb, and roebuck. A considerable quantity of pottery was also found.

A very interesting description of an ancient cranium, found in the course of excavations recently made at Gibraltar, by Captain Brome, was communicated by Mr. George Busk. The exact locality in the rock from which the skull was obtained could not be stated with certainty; but when first received, it was covered with a thick, hard concretion, composed in part of siliceous sand, to all appearance like sea-sand agglutinated by a calcareous cement. In general outline the Gibraltar skull resembles the Neanderthal calvarium, except that the supra-orbital projection is not so great; but it retains, besides the calvarium, the entire face, most of the teeth in the upper jaw, nearly the entire right temporal bone, with the external auditory opening, and the mastoid process, and a small portion of the foramen magnum. Compared with the three lower races of existing man, the Gibraltar skull most nearly resembles the Tasmanian, especially in its lowness. The nasal part of the face is broad and convex, the nasal opening is wide, and from the projection forward of the central part of the face, and the great width and rotundity of the jaw, the skull derives a peculiar and animal-like expression.

In a notice of some rare Scotch plants Professor Balfour stated that he had found Sagina nivalis, a Scandinavian plant, on Benlawers and on Binnain, a mountain near Ben More in Perthshire: also Phyllodoce cærulea on the Sow of Athole in Invernesshire. Specimens of several plants confined to single localities in Scotland were exhibited.

Physiology. (Subsection D.)

In an important paper "On the Inhalation of Oxygen Gas," Dr. W. B. Richardson pointed out that the influence of oxygen, when inhaled, was modified, 1st, by dilution of the oxygen; 2nd, by dilution of the blood; 3rd, by the activity of the oxygen; 4th, by the presence or absence in the blood of substances which stop combination. It is necessary that the oxygen should be in some measure diluted, for

neutral oxygen does not combine with the carbon of the blood unless it is diluted. The death of animals in pure oxygen is not by a narcotic poison, but by a process of negation. By a dilution of the blood to the specific gravity of 1,060 the absorption of oxygen is increased to a maximum; when further diluted, the absorption declines. Fresh oxygen prepared from chlorate of potassa increases the activity of the functions; but if exposed to ammonia, decomposing animal matter or even living animals, it loses its activity, and no longer combines with the blood. Alcohol, chloroform, opium, and certain alkaline products formed in the blood in disease prevented absorption of oxygen, and death not uncommonly took place from this cause.

The same physiologist communicated a paper "On the Physiological Effects of Tobacco," in which the composition of the products of combustion of tobacco, their physiological action on the body, and the effects of ordinary and excessive smoking were considered. The paper was full of detail, so that to furnish an intelligible abstract in a brief space is difficult. The author concluded by saying, that in the main, smoking is a luxury which any man is better without, but of nearly every luxury, tobacco is the least injurious. It is innocuous as compared with alcohol; it does infinitely less harm than opium; it is in no sense worse than tea; and, by the side of high living, altogether contrasts most favourably.

In an elaborate report "On the Physiological Action of the Nitrite of Amyle," Dr. Richardson pointed out the various effects which he had observed it to produce upon the animal body, amongst the most remarkable of which, we may especially refer to the violent action it induces in the heart, with dilatation of the capillaries, followed by diminished power of the heart and contraction of the extreme vessels. It possesses the power of so reducing the respiration and circulation, that a state precisely analogous to trance or catalepsy is induced. It is not an anæsthetic.

Various papers were read by Dr. Cobbold on meat, vegetables, fruits, and water, as sources of Entozoa. He described the various species of entozoa found in the flesh of animals used as food; he referred to the difficulty often experienced in detecting them, and stated, that eating raw or half-cooked meat, was a frequent means of introducing parasites into the human body, all danger of injury to man being avoided when a proper temperature is employed in cooking. From the fact of vegetables harbouring various small molluscs, the ova of entozoa may be introduced into the system, for multitudes of small parasites are not unfrequently contained in these molluscs. The more filthy the water or liquid manure employed to secure the fertility of the garden the more likely were the vegetables to harbour entozoa. The most careful washing was therefore necessary, and even soaking vegetables in brine before cooking might at times be advisable. Fruit, as far as the author knew, was never a source of entozoa. Fresh spring water was perfectly innocuous, but water stored in tanks often contained parasites and their ova. Drinking water into which the

carcases of dogs and other animals had been thrown should especially be avoided.

Dr. Boyd communicated an elaborate statistical paper on the measurements of the head and weight of the brain in 696 cases of insanity, of which it would be difficult to give a satisfactory account without constant reference to the tables with which the paper was illustrated.

Dr. William Turner related an example of that very rare description of cranial deformity, termed by Welcker, Trigonocephalus, which he had met with in a boy *æt.* five and a half years, the son of Irish parents. The peculiarity of this form of skull consisted in an absence of frontal eminences and consequent flattening or even hollowness above the eyebrows, together with a very remarkable beak-like projection of the forehead in the middle line. The characteristic shape was noticed in the head of this boy at the time of birth. His intelligence was quite on a par with that of children of his age and condition of life.

In a paper "On Obliteration of the Sutures in one class of Ancient British Skulls," Dr. Thurnam pointed out that in British dolicocephali there is a great tendency to obliteration of the sutures generally, but that such obliteration is not of so frequent occurrence in the sagittal suture as to warrant the conclusion that the dolico-cephalism depends on the synostosis. In the great majority of cases the obliteration is of the prematurely senile description. The obliteration was compared with obliteration of the sutures seen in the African race, and referred to the same cause, *viz.* an exuberant ossification. The author was of opinion that the post-coronal depression frequently observed in dolico-cephalous skulls, may, in some instances, of ancient British skulls from the long barrows, be produced by artificial compression.

It was argued by Mr. J. S. Prideaux in a paper "On the Functions of the Cerebellum," that there is a constant relation between the size of the median lobe of the cerebellum and the motor power of the animal, and between the size of its lateral lobes and its sensibility.

Mr. Alfred Haviland communicated a paper "On the Hour of Death in Acute and Chronic Disease," in which he stated that the greatest mortality took place in the early hours of the morning when the powers of life were at their lowest ebb.

Dr. T. A. Carter gave an account of the origin and arrangement of the superficial branches of the lymph vessels in the liver of man and of the pig. His object was to show that there is a direct communication between the capillaries and the finest lymph vessels in this organ. In favourable sections he had seen very minute injected processes coming off from the hepatic capillaries and uniting with others to form a primary lymphatic radicle. He also described a peculiar relation between the hepatic artery and the lymphatics of the liver, two lymph vessels united at intervals by short transverse branches accompanying each branch of the artery. With each expansion of the

artery the lymph vessels are compressed, and their contents propelled towards the heart.

Dr. E. Crisp gave an account of the mammalia in the abdominal veins of which he had observed the presence of valves. He also read a paper "On the Size of the Blood Corpuscles in relation to the Size of the Animal, its Organization and Powers of Endurance," the object of which was to show that the opinion generally entertained that the largest animals in the same family had the largest blood globules, was erroneous in many instances.

Mr. R. Garner described a small organ situated at the base of the middle pair of legs of Corixa, an abuatic insect, by the passage of air through which he supposed the characteristic sound produced by the insect was occasioned.

Mr. J. T. Dickson read a paper "On Cell Theories," in which he argued against the formation of cells out of inorganic matter, on the theory of manufacture of Mr. Rainey. He then offered a cell theory in which he assumed life to be an essential element, existing in the molecules, of which a homogeneous mass is composed, the molecules aggregating to form nuclei, from which cells are developed.

An account of the composition and uses of the horse-chestnut was given by Dr. John Davy. His examination comprised the nut, leaves, wood, pith, and bark of this tree, and he concluded that it deserved more attention in an economic point of view than it had yet received.

NOTES AND CORRESPONDENCE.

On the probable Existence of the Repetition of Octaves in the Solar Spectrum. By C. Hilton Fagge, M.D., Lecturer on Experimental Philosophy at Guy's Hospital Medical School.

In his paper, in the October number of the 'Quarterly Journal of Science,' Mr. Balfour Stewart, while comparing the phenomena of radiant heat and light with those of sound, remarks that there is not a complete *octave* in the visible spectrum—that the most rapid undulations which give rise to the sensation of sight have less than double the velocity of those which are least rapid.

This observation suggested to me the thought, that, probably, just as the ear perceives the identity of one note with another which is an octave higher, so the eye would derive the impression of the same colour from two rays, the wave-length of one of which should be half that of the other, assuming both to possess the power of acting upon the retina. Thus one can conceive, that if our power of vision were *less limited*, the spectrum, with the actinic and thermal rays, would represent a scale in which the colours would repeat themselves in regular order, just as the notes do in the musical scale.

We have, I think, an evidence that this is the case, in a fact which had often puzzled me; I refer to the presence of violet beyond the blue in the spectrum, so far from the red, which, by its combination with the blue, would form violet. If the colours be arranged in a circle, the violet forms a gradation between the red and the blue, just as the orange does between the red and the yellow, and the green between the yellow and the blue: and the linear arrangement has always seemed to me to be an unnatural one. I now believe that the red which thus appears in the violet at the upper extremity of the spectrum, is not the red which is perceived at the lower extremity, but the red of an octave higher (so to speak), the lower edge of which happens to fall within the limits in which ethereal waves are capable of producing the sensation of light. It would follow, that if the actinic rays immediately above could be seen, they would appear as red light. It is of course no objection that after passing through certain liquids they appear as blue rays; for it is admitted that a change in their refrangibility, and in their wave-length, has then taken place.

It appears to me that this view suggests several interesting points for inquiry to those who are provided with the means of experimenting upon this subject. If the colours would repeat themselves in the spectrum were it not for the imperfection of our organs of vision, is it not probable that fixed lines and absorption bands may repeat themselves also? It is well known that the colour of a surface was found by Melloni not to affect its power of absorbing obscure heat, that is to say, heat of great wave-length. But Professor Tyndall,* with his more delicate apparatus, was able to detect the influence of colour, on the absorption even of obscure rays. Is it not likely that a coloured surface which absorbs visible

* 'Lectures on Heat considered as a Mode of Motion,' p. 289.

rays of a certain wave-length would also absorb, in preference, rays having half that wave-length—in fact, those situated an octave lower in the scale? The relation between the absorptive and radiating powers of bodies for rays of the same refrangibility has been compared to the phenomena of consonance: and we have in these phenomena a strict parallel for the idea which I have just ventured to throw out. Thus, to give an illustration,* Count Schaffgotsch, while experimenting on singing flames, found that the flame could be set in vibration by sounding not only its fundamental note, but also other notes nearly allied, such as the octave.

So, again, it might perhaps be found that corresponding to the bright yellow line produced in the spectrum by sodium, a line of great heat exists also among the non-visible rays, at the point where the wave-length is half that of the visible yellow ray; and absorption-lines may be found to exist in the lower part of the spectrum, in corresponding positions.† If this should be so, we should be able to ascertain the exact length of the different parts of the spectrum, and the distance at which a given ray repeats itself. I do not know how far these points may be capable of determination from mathematical data.

As I have myself no means of working out this subject experimentally, I have thought that it might be worth while to suggest these points as worthy of investigation by those who have greater facilities for testing their truth.

C. Hilton Fagge, M.D.

Guy's Hospital, Oct. 1864.

P.S.—I have since found that Sir J. P. Herschel* obtained light of a lavender-grey hue by concentrating the ultra-violet rays with a lens. He describes, however, these rays as "lying *far beyond* the ordinarily visible violet," so that they probably included rays of very different wave-lengths, collected together; and I do not think that this observation can be regarded as disproving the explanation which I have ventured to suggest, of the occurrence of the violet rays at the upper end of the spectrum. I cannot find that any writer on the subject has thought of it as a fact requiring to be accounted for.

* 'Phil. Mag.' Dec. 1857, p. 542.

† A tolerably close acoustical analogy for this supposition may be found in the well-known fact that, when those strings of musical instruments which produce the deeper notes are struck, besides the fundamental note, the octave is heard.

On the Vast Antiquity of the Lunar Surface. By James Nasmyth.

The views I entertain on this subject are that, as a direct consequence of the small mass of the moon, and its comparatively large surface in relation to its mass, the moon must have parted with its original cosmical heat with much greater rapidity than in the case of the earth; consequently the moon must have assumed a final condition of surface-structure ages before the earth had ceased from its original molten condition. The moon, in all reasonable probability, never possessed an atmosphere or water envelope (it certainly has neither now), while the earth has both. The earth's atmosphere — and especially its ocean, when it existed in the first instance as a vast vapour envelope, ere the earth had cooled down so as to permit the ocean taking up its final position *as an ocean*—this mighty vapour envelope must have retarded the escape into space of the cosmical heat of the earth millions of

* 'Phil. Trans.,' 1840, p. 19.

ages after the moon had assumed its final condition as to temperature; and we have every reason to conclude that it was the passing-off of the original cosmical heat of the moon and of the earth that induced those actions, which resulted in the present structure and condition of their surfaces.

It is from such considerations I am led to the conclusion that the moon's surface-features, down to their minutest details, present to our view objects the antiquity of which is so vast that the oldest geological formations of the earth (inconceivably ancient as they are) are *comparatively* quite recent.

Such considerations appear to me to enhance so greatly the deep interest which ever attends the examination and contemplation of the moon's wonderful surface, that I would earnestly urge those who agree with the soundness of these views to bear them in mind when next they have an opportunity to behold the marvellous details of the lunar surface, for I would fain believe that in so doing the interest of what is there and then revealed to them will be rendered vastly more impressive.

JAMES NASMYTH.

Penshurst, Kent, Dec. 5, 1864.

Books received for Review.

From *Messrs. Longman & Co.*:—

THE LIFE OF ROBERT STEPHENSON, F.R.S. By J. C. Jeaffreson, Barrister-at-Law. With Descriptive Chapters on some of his most important Professional Works, by William Pole, F.R.S. Plates and Woodcuts. 2 vols. 8vo, cloth. 740 pp.

NOTES UPON THE ERRORS OF GEOLOGY; Illustrated by reference to Facts observed in Ireland. By John Kelly, Vice-President of the Royal Geological Society of Ireland. Plates. 316 pp. Post 8vo, cloth.

HARMONIC MAXIMS OF SCIENCE AND RELIGION. By the Rev. William Baker, M.A., Vicar of Crambe, near York. 170 pp. Post 8vo.

From *Messrs. Williams & Norgate*:—

THE PRINCIPLES OF BIOLOGY. By Herbert Spencer. Vol. I. 480 pp. 8vo, cloth.

From *Messrs. Routledge & Co.*:—

BRITISH AND GARDEN BOTANY; consisting of Descriptions of the various Flowering Plants, Ferns, and Trees indigenous to Great Britain, with Notices of all Plants commonly cultivated in this Country for Use and Ornament; preceded by an Introduction to Structural Physiological Botany. By Leo H. Grindon, Lecturer on Botany at the Royal School of Medicine, Manchester. 230 Woodcuts. 880 pp. 8vo.

From *Messrs. Churchill & Sons*:—

A MANUAL OF PRACTICAL HYGIENE; intended especially for the Medical Officers of the Army. By E. A. Parkes, M.D., F.R.S., Professor of Military Hygiene at the Army Medical School. With Numerous Engravings. 650 pp. Demy 8vo.

THE PRINCIPLES OF HUMAN PHYSIOLOGY. By William B. Carpenter, M.D., F.R.S., F.G.S., F.L.S., &c., &c. 6th edition. Edited by Henry Power, M.D. Lond., F.R.C.S.

From *Messrs. Lovell Reeve & Co.*:—

A MANUAL OF CHEMICAL ANALYSIS, QUALITATIVE AND QUANTITATIVE. For the Use of Students. By Henry M. Noad, Ph.D., F.R.S. 675 pp. Post 8vo. 109 Woodcuts.

From *Mr. Robert Hardwicke*:—

THE ASTRONOMICAL OBSERVER: a Handbook to the Observatory and Common Telescope. By W. A. Darby, M.A., F.R.A.S., Rector of St. Luke's, Manchester. 140 pp. Royal 8vo.

From *Messrs. Didier & Co., Paris*:—

LA PLURALITÉ DES MONDES HABITÉS. Étude où l'on expose les conditions d'habitabilité des terres célestes discutées au point de vue de l'Astronomie, de la Physiologie et de la Philosophie naturelle. Par Camille Flammarion, Rédacteur du 'Cosmos,' etc. 2me édition. 575 pp. Post 8vo.

From *the Author*:—

THE SIMPLICITY OF THE CREATION; or, the Astronomical Monument of the Blessed Virgin; a new theory of the Solar System, Thunderstorms, Waterspouts, Aurora Borealis, &c.; and the Tides. By William Adolph. 2nd edition. 380 pp. Post 8vo.

PAMPHLETS.

SERICULTURE IN OUDH. By Dr. E. Bonavia, Hon. Sec. Agri-horticult. Soc. of Oudh. 20 pp. Roy. 8vo. (Lucknow: R. Craven.)

BRITISH FOSSILS. ON THE STRUCTURE OF THE BELEMNITIDÆ; with a Description of a more complete specimen of Belemnites than any hitherto known, and an Account of a new Genus of Belemnitidæ, Xiphoteuthis. With Plates. By Thomas H. Huxley, F.R.S., &c. (Memoirs of the Geological Survey of U. K.) (From the Author.)

MEMOIRS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN, AND OF THE MUSEUM OF PRACTICAL GEOLOGY; the Geology of parts of Middlesex, Hertfordshire, Buckinghamshire, Berkshire, and Surrey. By William Whitaker, B.A., F.G.S. 112 pp. 8vo. *Engravings.* (From the Author.)

INDICATIONS OF THE PATHS TAKEN BY THE NERVE-CURRENTS, AS THEY TRAVERSE THE CAUDATE NERVE-CELLS OF THE SPINAL CORD AND ENCEPHALON. By Lionel S. Beale, M.B., F.R.S. Engravings. 8vo. 8pp. (John Churchill & Sons.)

ON THE GROWTH OF THE JAWS. By G. M. Humphry, M.D., F.R.S. Plate. 6 pp. 4to. (Cambridge: From the Author.)

THE NEANDERTHAL SKULL: its peculiar Conformation explained Anatomically. By J. Barnard Davis, M.D. 16 pp. 8vo. (From the Author.)

DE L'ALIMENTATION DES ENFANTS. Mémoire de Mme Baines, à Londres, imprimé dans les Annales de l'Association Internationale pour le Progrès des Sciences Sociales, Gand. 4 pp. Post 8vo. (From the Author.)

EXPERIMENTS TO DETERMINE THE EFFECT OF IMPACT, VIBRATORY ACTION, AND LONG-CONTINUED CHANGES OF LOAD ON WROUGHT-IRON GIRDERS. By William Fairbairn, LL.D., F.R.S. (Philosophical Transactions.)

DE LA GUÉRISON DES FIÈVRES INTERMITTENTES ET LARVÉES AU MOYEN DE L'OS DE SÈCHE ET DE L'ÉCAILLE D'HUITRE. Par M. N. Brault, Docteur en Médecine, et E. Peneau, Pharmacien de 1re classe. 27 pp. 8vo. (Jollet: Bourges.)

PERIODICALS, AND PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE MINING AND SMELTING MAGAZINE. (Simpkins & Co.)

THE GEOLOGICAL MAGAZINE. Edited by T. Rupert Jones, F.G.S., and Henry Woodward, F.G.S., F.L.S. (Longmans.)

THE JOURNAL OF BRITISH OPHTHALMOLOGY, AND QUARTERLY REPORT OF OPHTHALMIC MEDICINE AND SURGERY. Edited by Jabez Hogg. (Churchill & Sons.)

THE CANADIAN NATURALIST AND GEOLOGIST, WITH THE PROCEEDINGS OF THE NATURAL HISTORY SOCIETY OF MONTREAL. New Series. Vol. I. No. 3. (Montreal: Dawson, Bros.)

PROCEEDINGS OF THE ROYAL ASTRONOMICAL, ROYAL GEOGRAPHICAL, GEOLOGICAL, ZOOLOGICAL SOCIETIES OF LONDON.

JOURNAL OF THE CHEMICAL SOCIETY. (Baillière.) (From the Society.)

BULLETIN MENSUEL DE LA SOCIÉTÉ IMPÉRIALE ZOOLOGIQUE D'ACCLIMATATION. (Paris.) (From the Society.)

PROCEEDINGS OF THE COTTESWOLD NATURALISTS' FIELD CLUB FOR 1863. Plates. Royal 8vo. (From the Secretary.)

TRANSACTIONS OF THE DUDLEY AND MIDLAND GEOLOGICAL AND SCIENTIFIC SOCIETY AND FIELD CLUB.

TRANSACTIONS OF THE NOVA SCOTIAN INSTITUTE OF NATURAL SCIENCE OF HALIFAX, NOVA SCOTIA. Vol. II. Part i. (From the Council.)

With 13 Plates and more than 70 Wood Engravings, Vol. I. (for 1864), 8vo, cloth, 21s.

THE QUARTERLY

JOURNAL OF SCIENCE,

CONTAINING THE FOLLOWING

ORIGINAL ARTICLES.

EDWARD HULL, B.A., F.G.S. The Coal Resources of Great Britain.
Dr. G. C. WALLICH, F.L.S. The Atlantic Deep-Sea Bed and its Denizens.
WM. CROOKES, F.R.S. The Atlantic Cable and its Teachings.
ROBERT MALLET, C.E., F.R.S. The Late Earthquake, and Earthquakes generally.
Dr. J. H. GLADSTONE, F.R.S. Lighthouse Illumination by Magneto-Electricity.
Dr. W. B. CARPENTER, F.R.S. The Conservation of Force Applied to Physiology. Part I. The Relation of Light and Heat to the Vital Forces of Plants. Part II. The Relation of Light and Heat to the Vital Forces of Animals.
Professor KING, Galway. The Reputed Fossil Man of Neanderthal.
Dr. SCLATER, M.A., F.R.S. The Mammals of Madagascar.
Sir J. W. F. HERSCHEL, Bart., D.C.L., F.R.S. The Solar Spots.
MARTIN SAMUELSON, C.E. Steam Navigation: its Rise, Progress, and Prospects.
WILLIAM TURNER, M.B., F.R.S.E. The Fossil Skull Controversy: Human Crania allied in Anatomical Characters to the Engis and Neanderthal Skulls.
Dr. AUG. VOELCKER. On Milk, and Dairy Arrangements.
JAMES NASMYTH. The Physical Aspects of the Moon's Surface.
J. SCOTT RUSSELL, C.E., F.R.S. Gun Cotton.
H. M. JENKINS, F.G.S. Brackish Water Fossils of Crete.
T. NUNNELEY, F.R.C.S.E. The History and Uses of the Ophthalmoscope.
CUTHBERT COLLINGWOOD, M.A., M.B. Oxon., F.L.S. Acclimatization.
D. T. ANSTED, F.R.S. Copper Mining in Tuscany.
BALFOUR STEWART, M.A., F.R.S. Radiant Light and Heat.
JAMES SAMUELSON, Editor. The Source of Living Organisms.
Professor TH. LACAZE DUTHIERS, Paris. The Formation of Coal.
WILLIAM FAIRBAIRN, LL.D., F.R.S. The Construction and Mechanical Properties of Submarine Telegraph Cables.
Dr. WILLIAM ODLING, F.R.S. The Proportional Numbers of the Elements.
ROLAND TRIMEN, Cape Town. The Butterflies of Madagascar.

CHRONICLES OF SCIENCE.

Agriculture.
Astronomy.
Botany and Vegetable Physiology.
Chemistry.
Geography.
Geology and Palæontology.
Microscopy.
Mining, Mineralogy, Metallurgy.
Photography.
Physics—Optics, Light, Heat, Electricity.
Sanitary Science.
Zoology and Animal Physiology.
Recent Scientific Progress in America.
Science: in the Provinces—in Asia.

REVIEWS OF BOOKS.

ORIGINAL NOTES AND CORRESPONDENCE.

REPORT OF THE MEETING AT BATH OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

JOHN CHURCHILL & SONS, NEW BURLINGTON STREET.

TO ADVERTISERS.

QUARTERLY JOURNAL OF SCIENCE.

SCALE OF CHARGES.

	£	s.	d.
Eighth of a Page, or under . . .	0	6	0
Quarter of a Page	0	11	6
Half a Page	1	1	0
A Page	2	0	0
Bills inserted	2	2	0